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Periodic Market Systems in South-East Ghana: A Study of their Spatial Relations for Development Planning

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PERIODIC MARKET SYSTEMS IN SOUTH-EAST GHANA: A STUDY OF THEIR SPATIAL RELATIONS FOR DEVELOPMENT PLANNING

by

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Dedicated to

Caroline

and

Tom

For their care

ABSTRACT

Based upon the need for the generation of simple models which could be utilized for development planning in the Third World, arguments have been advanced for the use of periodic market components as a convenient framework, since among other things, they exhibit varying degrees of central importance through which myriads of people, goods, services and information flow. In south-east Ghana, the marked flow of events through these markets, seems to be intricately webbed from the small places from which goods and people originate through the intermediate towns into the national economy.

In this thesis, attention will be focussed on the spatial distributional structure and patterns in the functioning of these periodic markets in south-east Ghana, a predominantly rural area. The purpose of the project is the identification of some planning sub-units through which the intricate web of flow of events are marked. The end-product is to provide some framework for an integrated development study of that rural part of Ghana under study. Graph-theoretic measures are freely used to design the framework of analysis; the analysis itself is based on a location-allocation model.

ACKNOWLEDGEMENT

In view of the fact that data collection for this study started in a very informal way, and therefore incorporated many hands, very many names should have been included here. However, this is not possible for reasons of space and time. To the numerous hands and brains not listed here, I owe a debt of gratitude.

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I wish to state however, that responsibility for all ideas expressed and methods adopted for the completion of this study in the present form are entirely my own.

A.K.A.

Waterloo
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CHAPTER I

AN OVERVIEW OF A PROBLEM

This introductory chapter is a discussion on the theme to which this thesis seeks to provide an understanding. The discussion traces the areas in which more studies on periodic market systems are required, and relates these to the concern of the thesis. To achieve this, the chapter is divided into four sections in addition to a summary section. In section 1.1, the argument is presented in a very general manner that periodic market systems can be studied with a view to organizing their structure and processes for development planning in some parts of the Third World. In section 1.2, the purposes of undertaking the study are spelt out concisely. In section 1.3 there is a trace of the problem as can be found in the literature on periodic markets. At the end of this section, we generalize on the expectations of the results of the study. This section merges into section 1.4, in which the three-fold hypotheses advanced for testing in this study are presented. The conclusion in section 1.5 retraces the argument, and relates its relevance to the next chapter.

1.1 The Problem

Despite the recent proliferation of material on periodic markets and their systems in rural areas of Africa, Latin America and Asia, there still seems to be grey spots unaccounted for in the interpretation of data and the theoretical expectations of these interpretations; the major areas in which arguments are inconclusive concern:

(i) the economic rationale for the existence and operation of periodic markets (Alao, 1972; Carol Smith, 1974; Webber & Symanski, 1977);

(ii) the spatial dynamics and related structure underlying systems of periodic markets (Adalemo, 1971; Alao, ibid; Scott, 1976), and;

(iii) the socio-religious-behavioral influences of market participants on the above characteristics (Carol Smith, ibid., and 1975; Smith, 1977).

While arguments rage in the interpretations of theory and data in terms of the above, there has of late been an escalating and urgent progression towards the need to fashion out of these periodic market systems, a paradigm for the transformation of the rural areas which they serve (Brown & Harvey, 1979; Ghosh, 1971; Hocking, et al, 1974; Smith, 1972). As intriguing as this planning interest has become, there are innumerable issues to be resolved if any effective and efficient planning framework is to evolve from the institutions and processes which periodic market systems exhibit. For the purposes of this study, these issues have been grouped into three mutually inclusive categories: first, it has been noted that on account of their essentially indigenous character, and the fact that such characteristics were discarded in the materially advanced countries before any 'modernization' progressed, any attempts to fashion out a planning framework, with periodic market systems as the fabric, are bound to meet with stiff opposition from a host of workers. The second issue is the caution that in spite of the long history of the

existence of these periodic markets in many places, they have exhibited an inability to generate an organized and highly monetized payment and distribution system; for example, they have been characterized as demonstrating a low level of transportation technology, and that they lack the tendency to generate a competitive spirit between participants as well as between places enclosed within their systems. The foundation of this argument is that the praxis of North American and West European development strategy which incorporated very positive aspects of these characteristics have not been demonstrated by any of the parameters characteristic of the systems of periodic markets; thus little or no energy need be expended in the fashioning out of periodic market systems any programs for development planning. Third, the argument has been made that on account of their 'informal' structure there may not be any standard and/or coherent methodological systems relevant to periodic market studies.

As cogent as these observations may sound, there have been increasing volumes of publications, counterposed to these arguments and other related issues. The thrust of these arguments simply stated is that the criteria delineated for the rejection of the potentials which the "durable and flexible institutions" (Eighmy, 1972, p. 313) of periodic markets exhibit are not sufficiently obdurate to obfuscate the study of these systems. (Good, 1975; Logan, 1972; Smith, 1977; Ward, et al, 1974.) Between these two schools of thought on the utility of periodic market systems for development planning, there are bound to be useful indices to guide action for future studies.

It is the intention of this thesis then to delve into these issues; but in view of the very wide perspective which such a study encompasses, and in view of the fact that other observations are just unfolding, the scope of the problem would be limited to the issues raised against the use of periodic market systems for development planning in the Third World.

1.2 Purpose of the Study

Within the defined limits of study, the thesis examines the spatial relations of periodic markets as are found in those parts of south-east Ghana (West Africa) where the 4-day market cycle is predominant. A basic assumption to the study is that since the organization of space and people for development planning could be understood more appropriately if explicitly stated objectives of the planning space economy are known and understood, an expatiation on the planning environment of the study region is a necessary prelude. However, since the argument on the propriety of the processes and structures of periodic market systems to development planning has been directed towards conditions in the Third World in general, it is deemed appropriate to establish a justification for our argument with general planning philosophies in the Third World. Given these dimensions of the planning objectives, processes and philosophies of the Third World in general, and our study region in particular, we would then seek to examine the characteristics of periodic markets as they relate to, or deviate from these objectives and philosophies.

The purpose of such analysis is to define the common denominators of both systems for incorporation into a methodological

system of theoretical significance to the structure of the development planning we seek to establish. To achieve our goal, the study is divided into three main sections. In the first part, we argue for the rationale of using periodic market systems for the generation of rural transformation in those parts of the Third World in which it provides necessary ingredients to the lifestyle of the people and landscape. We are guided in the argument at that point by the reasoning that for any cogent and coherent development framework to issue from these institutions, there would be the need for a coherent paradigm: such a paradigm should have sets of ideologies around which the tenets of this 'informal' sector could be structured.

In the second part of our study we argue that for policies to be truly 'modernizing', they must incorporate some enduring parameters of the 'organizational systems that bind together people and economic activities' (Logan, 1972, p. 244) in the local areas in particular, and the entire space economy in general. Finally, but essentially, the study aims to derive a locational efficiency structure for periodic markets in south-each Ghana; the construct of such analysis is found in those aspects of graph theory which emphasize the management issues inherent in the locational structure of periodic markets, if positive development planning results are to be expected. We argue within the constraints of our construct that the integration, accessibility, and management probability of market centres to the population of a region are an index of the locational efficiency of the system, and thereby its flexibility for development planning.

1.3 Theoretical Background

Initial contributions to the knowledge and importance of periodic markets began with the descriptive studies of markets in North Africa (Fogg, 1949), the Mediterranean world (Face, 1958; Mikesell, 1960) and parts of Asia (Allix, 1922). In conformity with the paradigm of the time*, these studies did not seek to establish any theoretical explanations for the markets studied; the surge towards the interpretation of periodic markets within classical theories is dated to Stine's work in Korea (Stine, 1962). Specifically, Stine's primary concern was with mobile firms and only secondarily with markets that operated periodically. His study showed that periodicity of market locations was the product of the agglomeration of several firms acting in space to minimize costs of production while, by implication, maximizing profits+. The spatial behavior of producing firms, Stine argued 'influences consumer behavior too, (for) . . . the consumer by submitting to the discipline of time is able to free himself from the discipline of space' (Stine, 1962, p. 70). The imprint of the aggregate behavior of consumers and producer firms was a locational pattern that Stine correlated with the Christaller-Losch hexagons of central place theory.

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*The regional method which dominated the focus of geographic enquiry up to the mid 60's emphasized an idiographic approach. Studies were therefore descriptive of place and explanations were either determinist, possibilist, or at best probabilist. .

+Herbert Simon's (1958) 'economic man' theory which explained human behavior in terms of profit motive was implicitly incorporated in this explanation.

On a recapitulation of the basic tenets of this theory, we note that first, central places exist mainly to provide the goods and services which their surrounding areas need. Second, central goods and services (or functions) fall into grades; each grade has its range which could be expressed in terms of an "upper limit" or a "lower limit" called the threshold. The upper limit results from spatial competition between centres of supply, or from the maximum distance consumers are willing to travel to obtain the goods or services offered at a centre at a price. Generally, low-order goods or services which need to be bought regularly are ubiquitous in location; the higher the order of central functions, the fewer the number of centres providing them, and therefore, the farther consumers have to travel to obtain them. Thus they have a wider range than lower-order functions.

The theoretical spatial result of this model of location of goods and services is that the areas of influence of centres are arranged in geometric patterns; the arrangement is in the order of the now famous fixed *K* idea. The rigidity of the *K* idea has been accorded much significance to the extent that interpretations in terms of places were directed towards finding flexibility in historical and geographical conditions to fit into the prescribed system of central places. In line with this sort of research, some workers have, since Stine's work, been concerned with finding in some version of central place theory, an integrated explanation for the existence, form and spatio-temporal structure of the periodic marketing systems found in the Third World. Publications by Skinner on

China (1964, 1965), by Berry (1958, 1967), Alao (1968, 1972), Hay (1971), Webber and Symanski (1973), Plattner (1973, 1976), and Hill and Smith (1972), are exemplary of such explanations.

As valuable as these studies have been in establishing a theoretical rationale for an otherwise neglected but important phenomenon in the rural areas of Third World regions, there has been a growing controversy over these interpretations of theory. First, central place explanations of periodic marketing have been criticized on account of the intrinsic value of theory. Noteworthy are the facts that the interpretations relate fundamentally to higher-order goods and services; and, to an emphasis on the demand functions of location which are expressed in such terms as 'range of a good or service' and, 'threshold of population' (Alao, 1972, p. 97). Over the issue of the order of goods and services, it stands to reason that where consumer preferences are mainly for low-order goods and services, there can be little expectation of finding the neatly laid out hexagons of central locations, since the ubiquitous nature of these goods make their availability throughout a system a logical expectation. In the rural areas of Third World regions where these marketing systems exist, and where goods and services exchanged are mostly of the lowest order (i.e., staples), we should expect no significant correlates between central place locational models and periodic marketing locational systems. On the issue of overemphasis on the demand functions of location, researchers argue that such 'neglect' of supply analysis presupposes an unreserved association between population density, its purchasing power, and spatial

locations relative to each other. We should expect that where one or more of these variables do not match up to the theoretical threshold, there can scarcely be the hexagonal patterning of settlements and their populations to support the economic activities these central places provide (Brush & Bracey, 1955; King, 1961; Webber, 1973-74).

Second, the use of central place theory in the explanation of the landscapes of periodic marketing has been criticized for its essentially economic emphasis. As stated above, the theory assumes an 'economic man' behavior on the part of the mobile firm and consumers in space and time in finding locations for marketing periodically. But, although our expectations from such variations in time and space should lead logically to a sequential scheduling of marketing locations (which periodic markets are about essentially), Stine's analysis rather 'provides a geographically adequate explanation of spatially fixed market structure' (Alao, 1972, p. 98) as exhibited by the theory of central places. Moreover, as will be demonstrated later, since periodic markets operate for more than economic reasons, the argument runs that there should be little emphasis in equating periodic market systems with central place theory, which are based upon the economic functions of space in North America and Western Europe.

In a third argument which was not specifically directed towards the divergences between central place theory and periodic marketing, it has been argued that universal applications of theories suppressed an understanding of space. The brunt of the argument was that

> since man usually enters into social relations of production in order to earn a livelihood and reproduce himself, spatial relations are derived from and defined by production relations (Blaikie, 1978, p. 268).

An extension of this argument is that since 'production relations' are a function of the interplay between nature and social organization (including technology), which on their own accounts, vary in space and time, it would be naive to search for unlimited replications of theory; for, such replications, where they are illogically induced, deny the dialectical processes of production relations from being fully developed. Noteworthy in the development of this production relation is that the relationships between nature and mode of production are not a fixed ratio: there are very close mutual interdependencies between spatial structures and the mode of production (Blaikie, et al, 1977), products of which vary at various stages of the interplay and interdependency.

Since by the tenets of these arguments, it has been indicated that Stine's work is deficient in an adequately sufficient and necessary spatial interpretation of periodic markets, care must be taken that for the purpose of evolving a complete economic-geographic theory of periodic markets, there must be a spatial theory of the system. Such a system, Alao argued, must be 'carried out within a framework or paradigm that facilitates the construction of meaningfully inductive generalizations about these markets' (Alao, 1972. p. 104).

Although there has been little or no specific response to Alao's (1972) paper*, the growing volume of published work from empirical data and deductive analyses suggest certain broad spatial commonalities of the locational patterns of market centres, and the behavior of marketers. To be precise, most of these studies have relied heavily on verbal descriptions of locational patterns and mechanisms (Adalemo, 1975; Scott, 1976, 1978), although of late, there has been an increasing interest in the statistical derivation of some of the structures and relations.

Of the verbal analyses, the attention drawn to the itinerant trader (and consumer?) in generating what has become known in the literature as market rings (Hodder, 1966, p. 52), or market circles (Poleman, 1961, p. 62), market circuits (Harvey, et al, 1974, p. 37) or market components (Brown & Harvey, 1977, p. 1264) is very popular+. Common to the concept are that:

(i) there can be defined as a region a cluster of markets with a known order of marketing days (these might be 2-, 3-, 4-, 6-day cycle of market incidence at a centre; or alternatively a weekly or bi-weekly fixed day markets);

(ii) within such a defined region, there is a known order of marketing activity taking place from one centre

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*Note that this paper was derived from Alao's (1968) paper which was written partly as a response to Hodder's (1966) adaptability of Stinc's concepts to Yorubaland. Most of the other studies have curiously referred to Hodder and Alao (1968), rather than this paper, in the establishment of spatial models of periodic markets.

+These terms have been used interchangeably in the literature on periodic markets. This 'tradition' will be maintained in this study.

> to the other in an integrated sequence of days.

Since within each such region (no matter the size), more than one market centre would hold its market schedule on a particular day, itinerant traders have to decide on which centre to visit on particular days of the week. Although the bulk of materials have suggested economic reasons of profit and distance for the decision of marketers to visit given centres, there has been suggested other reasons which contribute to the choice of markets by participants on market days. The commonest of the reasons deduced so far includes the integration which already exists among the nested markets in each system (Smith, 1977, p. 20); the other reasons suggested include the relation between centres in the system, on account of their accessibility to each other by vehicular (or other modern) transport system, or other locally available modes of movement in the local area (McKim, 1972), or still by the system of social networks and contacts (Good, 1974, p. 70). Recently, Scott (1978) has suggested the importance of specialization in crop production by place and seasons in attracting itinerant traders to markets within given systems.

Given this focus of market components as an integrated system in space, researchers were tempted to assume that each system was isolated from the other. Such initial conceptualization, which gained currency through studies by Berg (1968, pp. 18-19), Yang (1944, pp. 25-26), and Barth (1967, pp. 154-5), among others, has been described by Smith as "an hypothesis to be advanced (rather) than a universal finding to be accepted" (Meillassoux, 1971, p. 327).

In the search for models of periodic market components, researchers came up with the alternative view of 'partial' market components; tersely described, the view was that markets exist in 'a loose chain-mail pattern of rings stretching over most of the landscape' of adjacent rings (Ukwu, 1969). These rings are connected to each other by 'bridgeheads' which might be very important and/or famous collection points for the adjoining regions (Hodder, 1967, 1969; Adalemo, 1975; Wood, 1975). It might be said then that the recognition of such patterns of intra- and inter-circuit links of periodic markets generated the search for the development of planning schedules out of the system. This would not mean, however, that the potentials of this framework were not inductively recognized earlier on; there have been exhortations from researchers, including Fagerlund and Smith (1970), Johnson (1970), Poly Hill (1972), and Smith (1972, 1977). However, the most explicitly stated research call was made by Adalemo (1975). In conclusion to his study, "Traders' Travel Patterns, Marketing Rings and Patterns of Market Shift," he noted that:

> An understanding of the pattern of market rings or cycles is important not only in revealing the nature of interaction among nodes in the space economy. It also gives us a preview of how space should be organized for the development of the rural areas and, by implication, the whole of the national space economy (Adalemo, 1975, p. 26).

In Adalemo's view, the major advantage such an understanding could generate was that

> the approach gets us away from unnecessary attachment to central place theory and enables us to conceptualize market cycles in such a way as to deduce the nature of spatial interaction consequent on the number of ways they are defined (Adalemo, ibid, pp. 25-26).

What Adalemo might be said to be arguing for is that our understanding of periodic markets, (as market components) in order to be as attractive as it used to be under central place theory, has to be structured around some paradigm consistent with present needs and future demands. Critical to such conceptualization are many questions which we wish to pose: is there any readily available theory or set of related theories into which can be subsumed the current ideas on periodic market rings? Is such a theory amenable to the demands of development planning? If not, what reformulations, either of the theory, or of the ideas on periodic market circuits have to be made? Alternatively, what chances are there, of deriving some normative type model from periodic market component for the generation of development planning? If this should become possible, how can we transform current knowledge on market rings for the generation of a planning framework specifically for the 'poor' regions served by the system?

Given the present state of reported studies, there cannot be said to be any coherent and directed attempts to provide the required answers to any of these questions. The studies reported so far might be said to be directed towards the generation of models on the behavioral characteristics of market participants. In the first of such study, Harvey, Ming-Sung and Brown (1974) made use of the p-median algorithm to delineate planning regions in Sierra Leone. As useful as this pioneer study was, it lacked two critical ingredients required for our purposes: first, the designated regions were projected as some static organs which have no relation to each other.

The idea of bridgeheads was totally absent; thus the use of the p-median algorithm as a useful construct can be said to lack the dynamism which characterizes the movements and coordinations known to filter through these market rings. Second, data collected were on a macro scale (i.e., manipulation of all data from census reports on Sierra Leone). For such studies to be of value to micro regions in 'poor' regions demands that data be of finer grains, if any useful purposes are to be served. The realization of these constraints might be a factor in the 'reorganization' of Harvey's research team (Harvey, et al, 1974). Reporting on the valuable asset that the chromatic travelling salesman algorithm is to an understanding of delineating dynamic planning regions in rural areas, it was noted that:

> in any such (planning) situation, the implementation of strategy should be based on actual understanding of the region's physical geography, an inventory of existing infrastructure, and some knowledge of the socio-anthropological attributes of the population (Harvey et al, 1974, p. 51).

It is relevant to note than an overconcern of this group of researchers for the statistical finesse and logic of algorithm was so overbearing that very little attention was given to the role, if any, of periodic market circuits in development planning. As if in a bid to atone for these earlier deficiencies, Brown and Harvey (1977) suggested and tested the implications in the manipulation of the assignment and bottle-neck assignment algorithms in delineating planning regions, using data on periodic markets. The compatibility between the concept of market rings, the algorithms and development planning

was so well documented in the paper that it has been deemed worth the replication in another region with different sets of "socio-anthropological attributes of the population." But more than merely re-organizing a construct, this study provides an initial attempt at subsuming the relevant aspects of periodic market rings into the development planning paradigm of Third World countries.

In this study, therefore, the expection is that by assembling empirical data at the micro-scale, the core of the questions posed for the use of periodic market systems for development planning are being pursued in a coherent manner, as has so far not been attempted. More importantly too, policy perspectives derived from actual Ghanaian experience are to be scanned within the derived constructs embedded in graph theory. Expected results can therefore be said to imply both theoretical and empirical implications towards further perusal on periodic market system's utility in planning for rural areas in the Third World.

1.4 Hypothesis

On account of the preliminary stages at which studies are on the derivation of a planning paradigm (i.e., a planning metaphysics, socio-anthropological attributes of population and periodic market systems, and a consistently logical construct or set of constructs) for Third World regions, the attempt in this study will be to show that given

(i) the actual conditions and behavioral patterns of marketers;

(ii) the actual planning environment and goals of planning in a region; and

(iii) a logically structured construct relevant to the above, some very pragmatic propositions, rather than abstractions, could be devised to project the roles which periodic market systems could play in the generation of a coherent system of development programs in the rural areas of the Third World regions, and by it the whole of the space economy of these regions.

Before we begin any formal analysis of our problem, we need to define a few concepts and consider the limitations of our study. These we turn to in the next chapter.

1.5 Summary of the Argument

In this chapter, the attempt has been made to show that the need to provide fuller understanding of periodic market systems ought to go far beyond their economic rationality, their spatial composition and organizational structure, and their socio-religious roles; the ultimate towards which the study of periodic market systems ought to be directed must be a theoretical construct that must be capable of being fashioned for the organization of planning and development. Thus, as useful as current trends of the studies on periodic market systems have been, there is the need for a remodelling of thought on the structure and systems of these periodic markets. The lack of material on this theme as currently holds has been noted; but the major point of note is that there should be an articulation of research of this kind in the future with the view of fashioning such themes for the organization of space. It is only with such research that there can be found a projection of the relations between patterns of market behavior by itinerant traders and consumers, and development planning.

CHAPTER II

CONTENTS AND METHODOLOGY

The concern of this chapter is to describe the structure of the analytical procedure adopted for this study, and to comment on the various methods by which the study was organized. Thus the chapter is divided into two main parts. The contents part is devoted to a brief introductory note on how the chapters have been organized as an aid to a clearer understanding of the theme of this thesis. This description is scheduled in section 2.1. In section 2.2 there are statements on the basic reasons for the choice of south-east Ghana as the laboratory of the analysis of data for this study. Definitions basic and somehow peculiar to this study are explained in section 2.3.

In the second half of this chapter under 'Methodology', we provide descriptions and explanations on how data were collected in the field, and the sources of other data used. This is the concern of section 2.4. Since in every research there are bound to be some levels and sources of error which might influence the results of analysis, we provide in section 2.5 the basic limitations of the data quality and the assumptions they imply for interpretation of our results.

CONTENTS

2.1 Format of the Study

Simply stated the aim of this study is to show that for a fuller comprehension of the systems of periodic markets, research need be organized with a view to linking the critical parameters of the system to a theoretical paradigm that is amenable to the development planning of the regions in which these periodic markets operate. To achieve this aim in a comprehensive manner, the chapters for the thesis are organized on the format shown in Figure 2.1.

It is recognized that a necessary prelude to an understanding of the theme of this study is the need to first illustrate in various ways, the nature of the region on which final analyses are to be used. Thus in Chapter III, we provide some basic and relevant information on the environment of the study region. The aim is to establish the fact that periodic market systems and their characteristics are a way of life in the study region.

After this brief introduction to the environment of the study region, Chapter IV traces the various points at which periodic market systems have been associated with various theoretical planning models. What the chapter seeks to achieve is to show that although after some time of 'association', central place and growth pole theories have been proven to be incompatible with the economic systems of periodic markets, as well as development planning models of the Third World, this is not sufficient reason to reject the characteristics and potentials which periodic market structures exhibit for incorporation into other planning models relevant to

OUTLINE OF THESIS

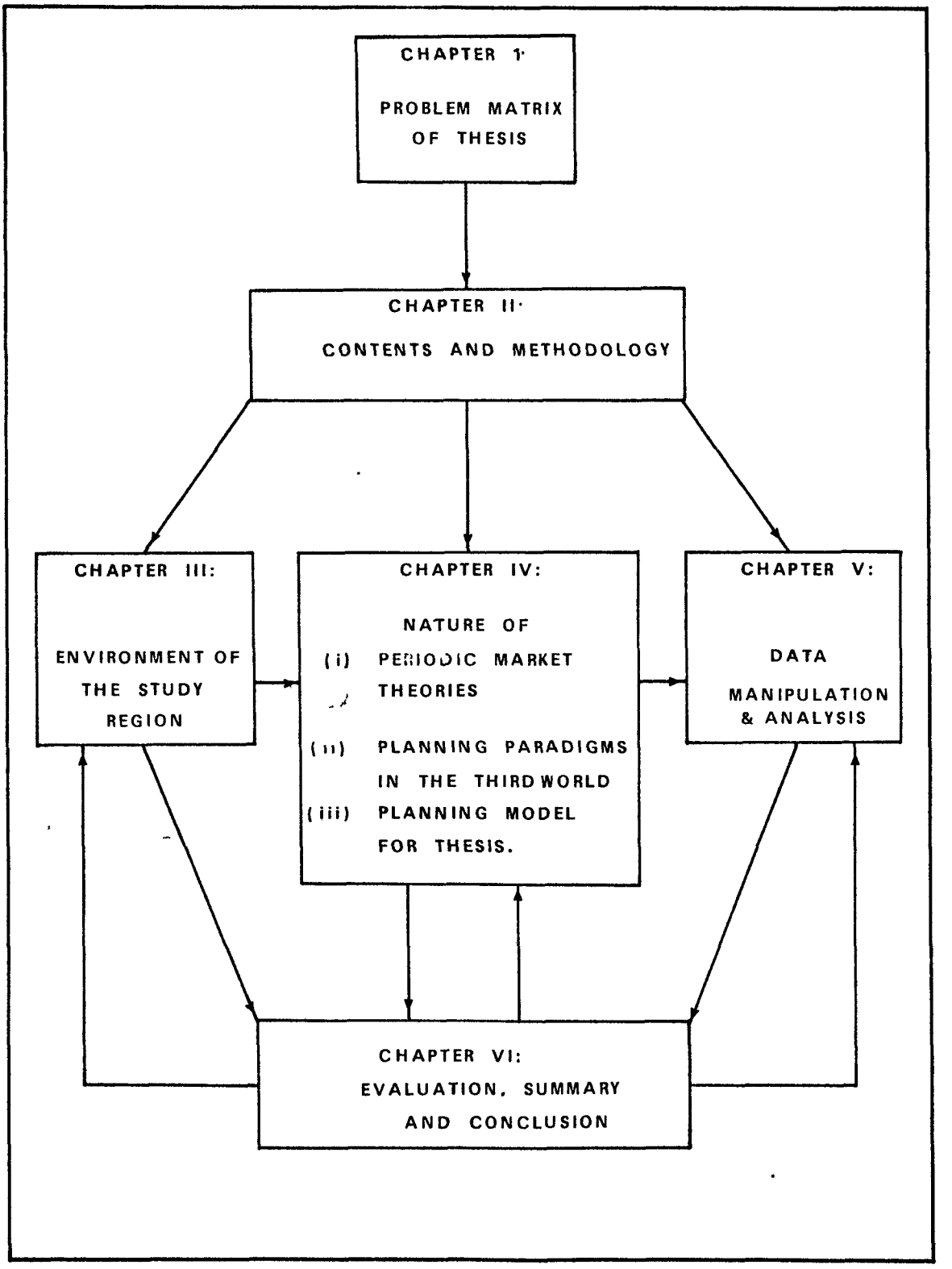

Fig. 2.1 : Format of analysis

Third World conditions. Thus in this chapter there is the attempt to show the correlations between periodic market systems and the 'autonomous' development planning paradigm suggested for the planning problems of Third World places. In the last part of this chapter, therefore, a simplified development model which emerges from the mesh between the two systems is propounded.

Having identified a model of planning, we attempt in Chapter V to organize data with a view to testing the preliminary strategies incorported in the model.

From these analyses, we expect some points of confirmation and divergence between the problem of our study, the environment of periodic market systems and the data organized for the thesis. We therefore provide an evaluation of the various degrees of divergences and confirmations by providing an evaluation of the research in Chapter VI. The expectation is that depending upon the degree of deviations, we might be in a position to test the significance of the arguments advanced in the context of data assembled, and thereby the logistics of using our observations and procedures. These are the points discussed under Evaluation in Chapter VI.

Each of these chapters is divided into sections in which variations in the themes advanced in each chapter are established.

2.2 Logic of Sampling

The choice of the study region as a laboratory for our purpose needs to be guided by conditions and variables consistent with most Third World regions; this is on account of the fact that any large discrepancies may put out of focus, any generalizations we may wish

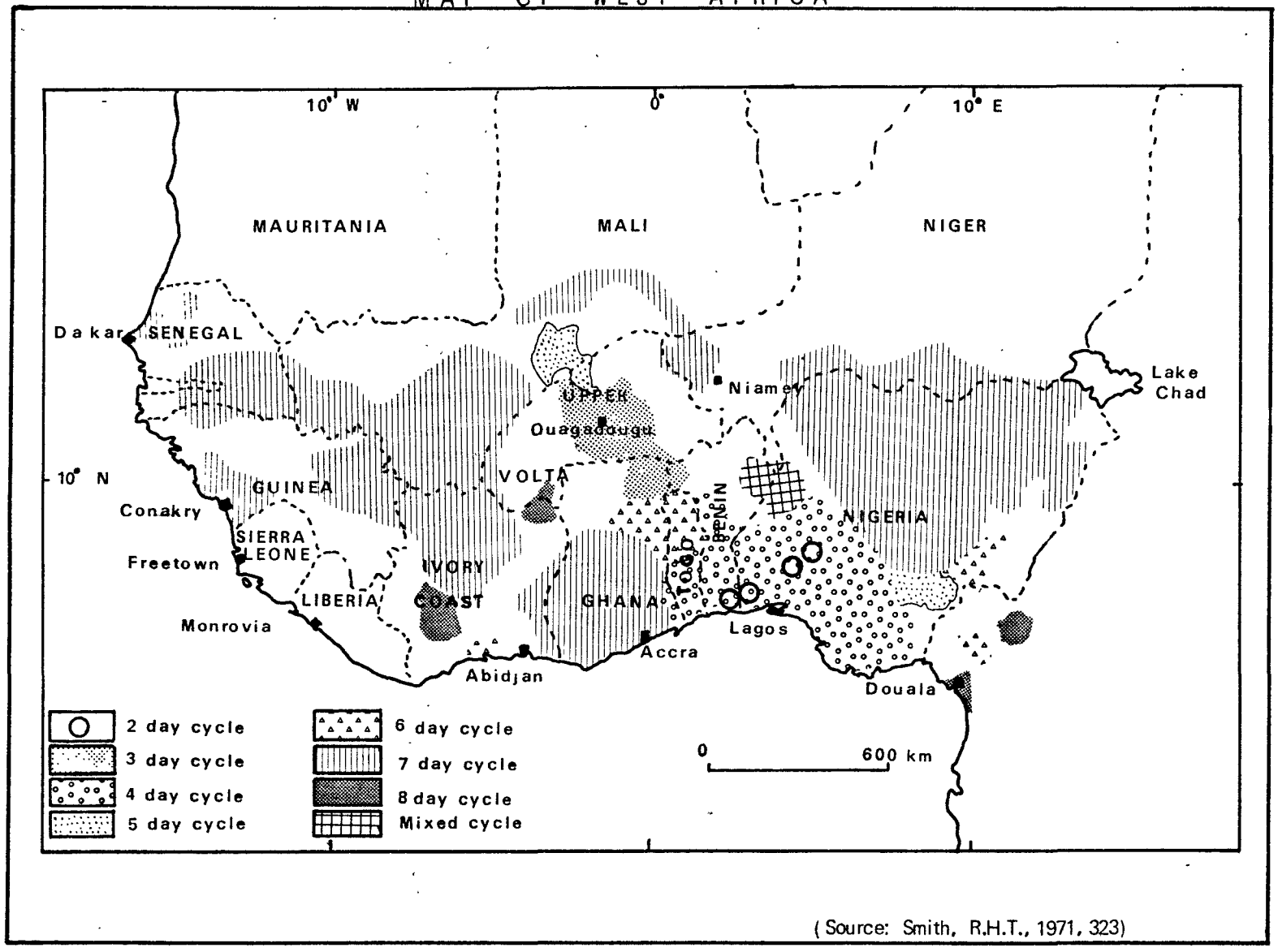

Fig. 2.2: Periodic market cycle regions in West Africa.

to make from such a preliminary study. Thus, a four-fold guide has been adopted.

First, the 4-day market cycle which defines the study region is a characteristic feature of a large section of West Africa shown in Figure 2.2. Although there may be variations among these places in terms of the socio-anthropological attributes of the populations, the uniformity in the 4-day cycle suggests that whatever pattern of development planning this preliminary study may stem could be made adjustable to a large area of West Africa. Second, the limits of the study region within the political boundary of Ghana are defined by a common and coherent language group of *Ewes*. This presupposes that the role of language as a barrier in the circulation of goods is minimized; but importantly too, as part of a nation state, most of the residents of the region are multilingual and therefore can act as 'bridgeheads' in the circulation of goods and services to other parts of the country. Third, the region is inhabited by a predominantly agrarian population as data in section 3.3 indicate. The virtual absence of manufacturing industry and employment therefore gives weight to the assumption that a large proportion of the population might be affected by whatever changes are effected in the agricultural potentials of the region. Last, the road transportation network has often been described as one of the most developed within the country (Ghana Handbook, 1977, p. 254). In spite of this political adjudication, figures provided on the analysis of networks in terms of some graph-theoretic measures in section 3.2 are an indication of network development of roads and market places. As

has been noted in that chapter, the network indices are consistent with general conditions in most Third World countries.

2.3 Definitions

A useful starting point of definitions is on the concept of periodic markets and market places. As defined by Polly Hill, a market place is "an authorized concourse of buyers and sellers of commodities, meeting at a place more or less strictly limited or defined, at an appointed time," (Hill, 1966, p. 295). The interpretation is that these market places have the sanction of the settlement locations either by themselves or by the accord of a whole community of settlements. The time incidence of these marketing activities is the critical factor in their operation. As may be sanctioned by a settlement committee or community, market periodicity may occur on every fixed day of the week; or they may occur on every 2nd-, 3rd-, 4th-, 5th-, or 6th-day. For the former type the designation 'fixed day' periodic market is applied; in the latter case, the designation is the 'n-day' cycle. Thus, for a 4-day cycle, market meetings are held on every fourth day after a meeting took place at a location.

The terms 'marketers' and 'market participants' have been used interchangeably in this study. No matter whichever is used, the designation refers to anyone who visits a market place on a market day. It should be noted that this use does not attribute any purpose to the visit, but it is assumed in the majority of cases, visitations are for either buying or selling or both. In some cases, however, these are not the purposes (see forexample, Smith, 1978, p. 13).

The term 'periodic marketing' is a referent to all processes which occur within a system of periodic markets. It includes the timing as well as the locational schedules; it therefore differs from the term 'periodic markets' which refers only to the place location of markets in a system. But periodic marketing is a sub-set of periodic market systems which define not only the marketing aspect of these markets, but the entire culture and value systems which are so incorporated. It is in the designation of areas encompassed by the culture and value systems that the term market rings or components have been introduced.* Although variously designated, periodic market rings are definable as 'a group of markets serving a specified area, and unified by a known order of market shifts' (Alao, 1968, p.3). Although Brown and Harvey have introduced functions of minimum distance travel in their definition, these are to be reserved only for considerations of planning regions.

METHODOLOGY

2.4 Data Sources and Collection

Data analysed in this thesis were assembled from three main sources: field studies, materials of restricted circulation, and other published material.

Field data were collected between the months of February and July, 1978 as a sample survey check on data published in a monograph by Van Appeldoorn on market centres in southern Ghana (Van Appeldoorn, 1972). Data collected under this sample survey check system

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*See section 1.3 for the synonyms of the concept.

included information on

(i) the variety of goods and services traded in at each of the market centres examined in this study and their sources.

(ii) market day cycle and sequence for all centres; and

(iii) the number of marketers present in each market in the course of a day's marketing activities.

Further, data were collected on distance between each of the centres identified as well as the travel time between them. (The results were compiled into Appendix I.) Although an initial attempt was made to assemble data on cost of travel between centres, the idea was dropped when it was found that the variables in the cost function were too subjective to be real in a study of this kind.

The data on source location of marketers and their numbers were compiled into the data file, in Appendix II. Data on market day cycle for the centres, the sources of marketers and the sequence of interaction within the region were built into Figure 5.1.

For each of these data sets, informal interviews and discussions were held randomly with selected market participants; 'market queens'*, traditional chiefs and local council chairmen were the

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*'Market queen' is a term applied to some established women traders at particular market centres. Although their role in the market place is as determinators of the price of commodities they trade in, sometimes they act as arbitrators in disputes between traders, or trading groups and council groups. In some markets, there may be more than one queen; this depends upon the size of the market and the range of commodities offered for sale in the market. Thus they have invaluable information on market operations. A 'queen' may have control over more than one market place.

main source persons in these interviews. These were complemented with very keen participant observations by the researchers. Data on the number of market participants and their source locations were collected by a random interview with persons arriving at market places.

Very general observations were also made on the crop ecological subdivisions of the study unit.

It is worth stressing that there are numerous market centres scattered all over the region which were not included in our analysis. This was for reasons that to be statistically relevant for this study, the centre must have a minimum population figure of 1,000 persons, and be able to attract at least 100 marketers on a market day. The choice of these figures, although arbitrary, was based on the large number of small settlements (see section 3.1) in the area which must be organized, if our data were to be meaningful for the purpose of this thesis.

The observations made on the peak hour* time of marketing was relevant in assigning values to the number of participants in the market place. Each centre was visited on at least three market days.

Data of restricted circulation were culled from two main sources. One was a set of papers presented at a conference in Kumasi, Ghana (December 1975 to January 1976), and was to be used as 'text for private study only.' A second source was classified as of

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*Peak hour time of marketing represents the period when the largest possible number of marketers are present at a market place. Although very varied, it is often between eleven in the morning and two in the afternoon. During this period, there may be 80 percent of all marketers for a day present in the market place.

restricted circulation in the sense that the monograph was published in the local language of the region of the study, and can therefore not be widely circulated. It is a monograph by Dzobo on the market cycles of centres in the region (Dzobo, 1977).

The final source of data (i.e., data from published material) included documents extracted from such publications as the Population Census of Ghana, topo maps and other relevant documents. An aspect of this source worth commenting on relates to the merge of population data and topo sheet location of settlements. As illustrated in Figure 2.3 a location like Denu (#61) has satellite locations around it, which while they form a spatial unit, have been documented in the Population Census as separate units (Table 2.1). Similarly, a centre like Afiadenyigba(#49) is made up of more than two minor centres separated from each other by a distance of not more than two miles. Although the listing in the Census is for two or more units (as the case may be) in this study, these population figures were added up to give the totals listed in Appendix III.

2.5 Limitations and Assumptions

As has been mentioned in the Acknowledgement, data collection was not designed specifically for the purposes of writing this thesis. As such a regularly and rigidly scheduled sampling method, as should be expected for a research of this kind, was not followed. This fact, coupled with the inability of the researcher to undertake a follow-up sampling have contributed to a limited interpretation of our results.

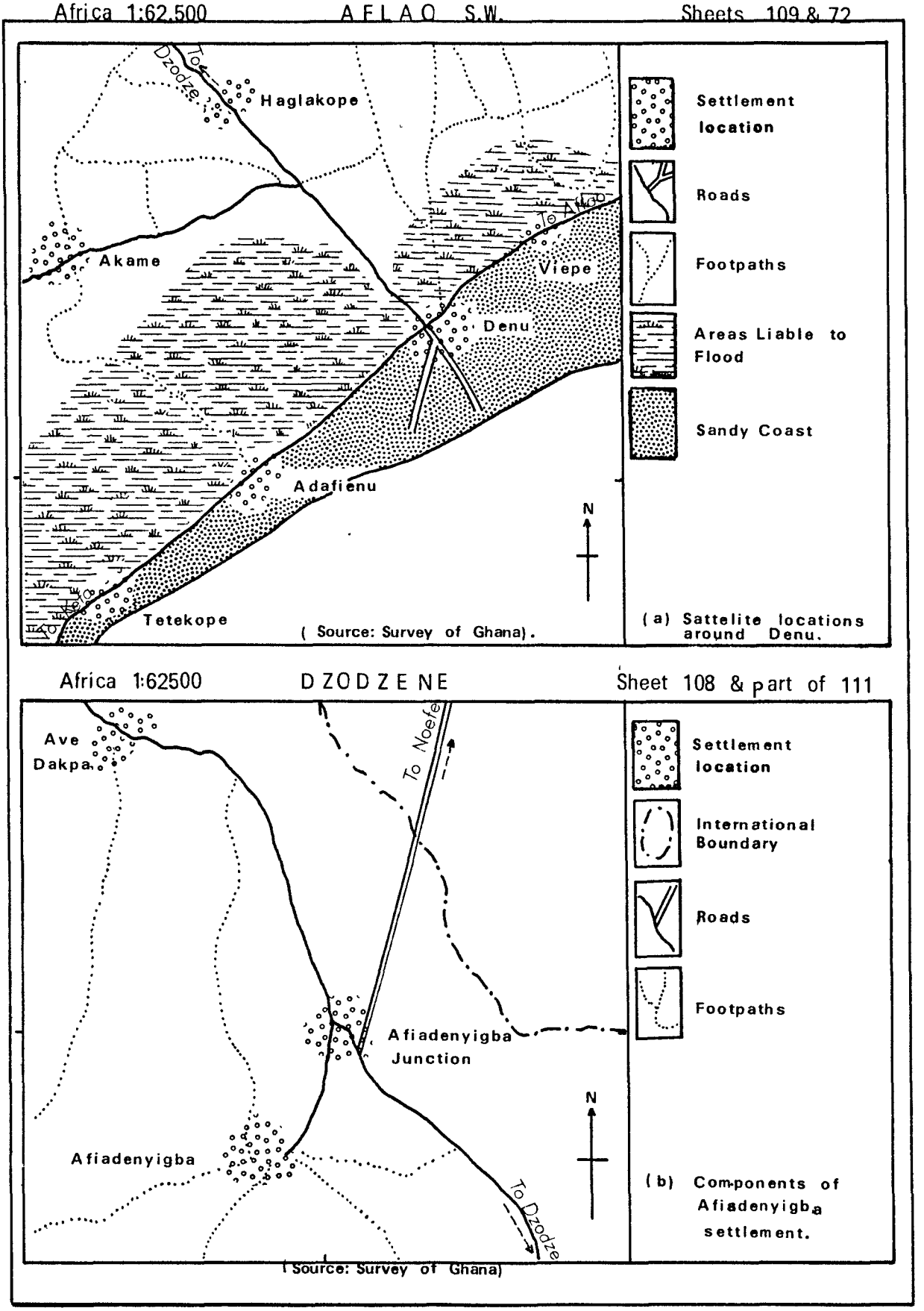

Fig. 2,3 : Sketch illustrations of settlement spatial structure at Denu and Afiadenyigba.

TABLE 2.1

POPULATION REPORTING FOR DENU (61) AND
AVE-AFIADENYIGBA (49) TOWNSHIPS

(a) Denu Township and Satellites

Settlement	Population
Denu	2475
Haglakope	574
Akame	312
Adidotoe	168
Kpotame	201
Viefe	638
Afegote	230
Adafienu	1514
Tetekope	230
Denu Kpondo	184
Total for Denu	6526

(b) Afiadenyigba Township and Divisions

Settlement	Population
Afiadenyigba (New Town)	611
Afiadenyigba Police Station	145
Afiadenyigba Gborgame	296
Ave-Agbozume	29
P.W.D. Camp	9
Afiadenyigba Tax Corner	682
Afiadenyigba Junction	16
Ave-Dakapa	2897
Total for Afiadenyigba	4685

Source: 1970 Population Census of Ghana, Special Report 'D', 1971, pp. 45-48 and 49-59.

Of significance in the interpretaion of sample data was the timing effect. The period of the start of data collection coincided with the commencement of cropping activity in this predominantly agrarian region. Thus, we expected a decline in the number of marketers circulating between markets, especially the part-time traders (see section 4.2). However, since by the end of the research period, commercial activity in these market places has reached its peak period (i.e., mid-June to end of July), it is to be expected that the figures tabulated are significant enough.

Data represented in Figure 5.1 as contact sequence schedules through periodic markets are only indications of movements by marketers between centres. It should be noted that movement schedules for purposes other than periodic marketing were therefore not represented. Thus, the capital city of Ghana, Accra, (#70) was shown to have only two edges to it. Similar caution is to be noted in terms of all other locations on the borders of the region of study. It is therefore misleading to assume that the calculation of the 'attraction factor' for these centres represent their true states. Thus, only data for the core area of the region is critical for a thorough analysis.

CHAPTER III

ENVIRONMENT OF THE STUDY REGION

The aim of this chapter is to provide an account of the characteristics of the study unit, as should be relevant for our comprehension of the role of periodic marketing as a way of life in the unit. Thus there is a complement between description and analysis of observations pertinent to periodic marketing.

To achieve this aim, we provide in section 3.1, a rather general overview of the environment of the study unit in terms of location and settlement distribution. Section 3.2 is devoted to a simple statistical analysis of the connectivity of places through the system of road networks and those of market place contacts. The structure of the occupational distribution of the population is described in section 3.3, and we draw a comprehensive conclusion, based on the above observations and analysis in section 3.4.

3.1 General Observations

The laboratory of this study, south-east Ghana, extends over an area of 20,651.8 square kilometers. As indicated in section 2.2, the limits of the region are defined by all places with a 4-day market cycle within Ghana* and as is shown in Figure 3.1. So defined, the unit occupies the southern three-quarters of that part

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*It should be observed that although centres with the 4-day market cycle extend into parts of the adjoining political unit of the Republic of Togo, emphasis in this study will be placed on those centres in Ghana.

SOME MARKET CENTRES IN SOUTH-EAST GHANA

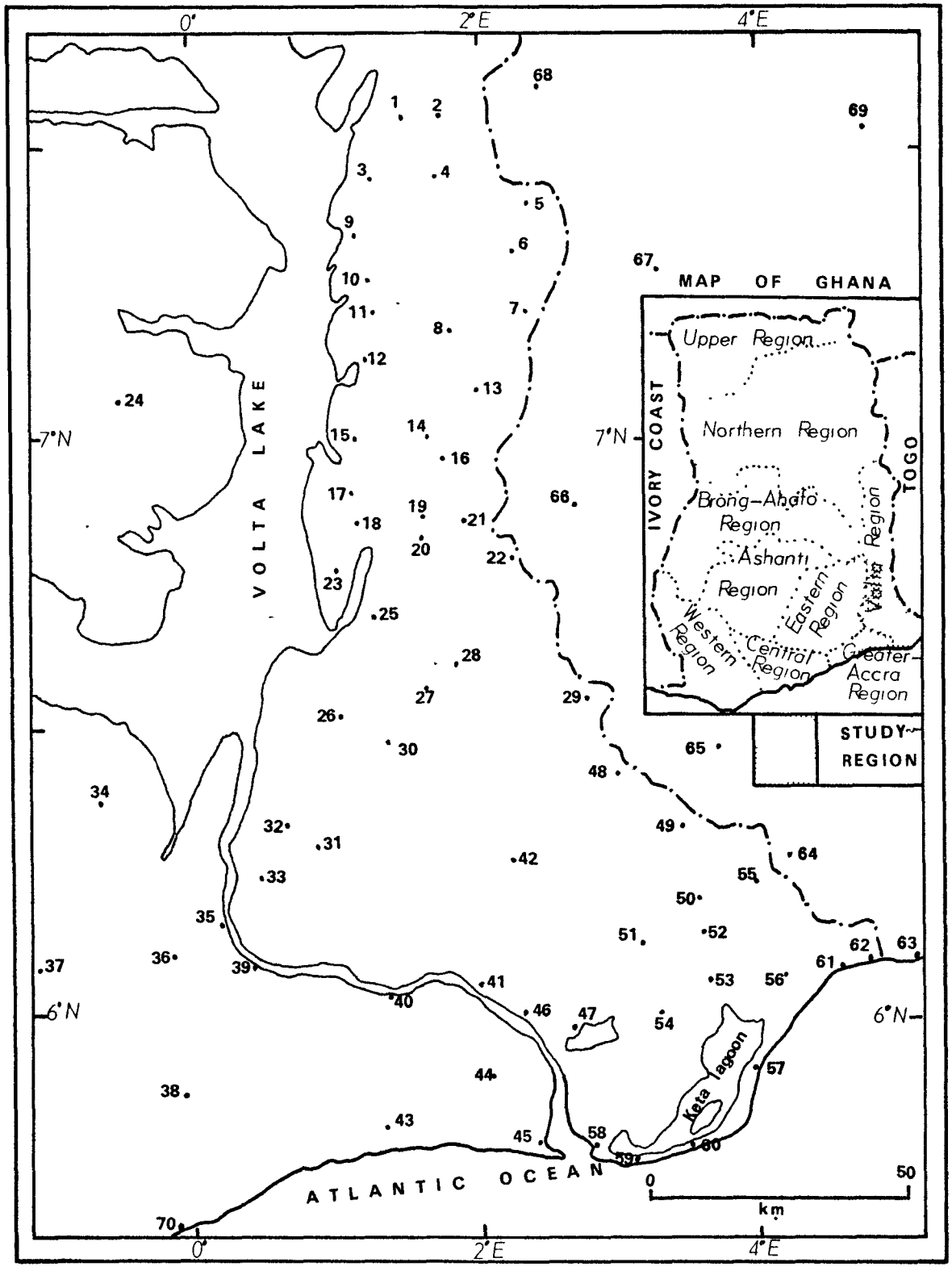

Fig. 3.1: Location of study region and centres studied.
(For place-name identification, see Appendix III).

of Ghana administratively designated as the Volta Region. The unit includes parts of the following political units of Ghana; the Eastern, Greater-Accra, and Brong-Ahafo Regions to the west, and the northern section of the Volta Region to the north. To the east of the region is the political unit of the Republic of Togo. The southern border of the region is the Atlantic Ocean.

The study region is inhabited by an ethnic group called *Ewes*; the domination of the unit by an ethnic group has been noted as a critical factor in the movement of goods, people and services as stated in section 2.2.

According to the 1970 Population Census of Ghana* there were 5647 human settlements in the study region. Total population enclosed by the region was 960,441 people. An arbitrary calculation from these figures shows that there were approximately 0.27 settlements per square kilometer af area. The population distribution was 46.5 per square kilometer. However, population distribution by individual settlements showed a range from as low as five persons per settlement to over 20,000 in Kpandu (#15) and Keta(#57).

A classification of the population by size, and compared to settlement numbers shows that 96.6 percent of all settlements have

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*The particular referents here are 1970 Population Census of Ghana, Special Report 'D' Volta Region, and Greater Accra and Eastern Regions. Data on Volta Region excluded the following local council areas which did not form part of the study region; Akan, Wawa and Kete-krachi; for the Volume on Greater Accra and Eastern Regions, data for only the following areas were included: Shai, Dangbe, Yilo-Krobo-Osudoku, and Manya Krobo, since a large segment of these areas were included in the study area.

TABLE 3.1

DISTRIBUTION OF SETTLEMENTS BY SIZE OF POPULATION

Population Size Range		Number of Settlements		Number of Population	
		Total	%	Total	%
1,000		5453	96.6	164,357	17.1
1,000	5,000	155	2.8	284,530	29.6
5,000	10,000	18	0.31	124,619	13.0
10,000	20,000	16	0.20	196,225	20.4
20,000		5	0.09	190,710	19.9
TOTAL		5647	100.00	960,441	100.00

Source: Adapted from 1970 Population Census of Ghana Special Report 'D' Volta Region and Special Report 'D' Greater Accra and Eastern Regions.

populations of less than 1,000 people (Table 3.1). Within the Ghanaian context then, only 0.59 percent of the settlements in the region are urbanized.* A hypothetical distribution based on the above figures shows that there are approximately 146 villages to an urban centre (i.e., adding up the total number of settlements with more than 5,000 people, and distributing into those with less than that figure).

3.2 Connectivity

It is worthy of notice that road transportation is the major communication mode in the region: there are neither train services nor regular air transport facilities between any of the centres in the region. Telephone services are more often than not in poor working condition between centres. Thus vehicular movements (including the use of boats) and person-to-person communication (by walking between points) are critical parameters in the region's connectivity measures. In Figure 3.2 we present a graphical illustration on the complement between walking distances and the popularity of vehicular movements for selected centres. We infer that there is a tendency to longer walking distances in the southern half of the region than in the norther sections. For Akatsi (#51) for example, people walk up to about 15 kms at a time; for Ho (#28) it is 8 kms, and for Hohoe (#8), it is 6 kms. Superficially, these differences in walking distance might be explained

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*The datum line for classification of a settlement as urban in Ghana is 5,000 people.

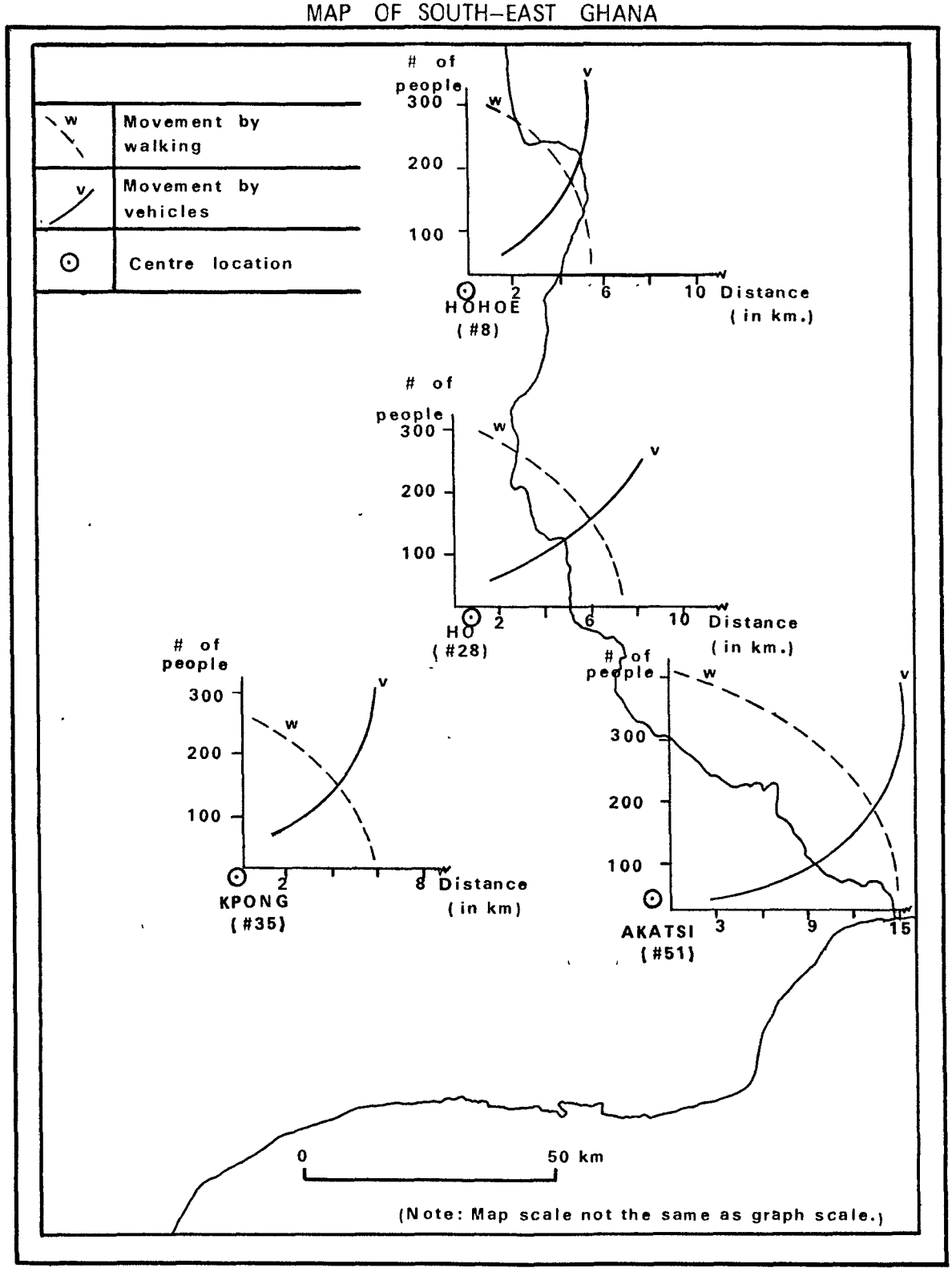

Fig. 3.2 : Walking range and vehicular movement trends at selected centres.

in terms of the topographical structure and vegetational differences of the various places, although other factors may be relevant. The southern portion of the region forms part of the extensive coastal plain region of West Africa (less than 200 meters a.s.l.) (Iloeje, 1972, pp. 67-68). The area is low-lying, and savanna-like in vegetation. The virtual absence of tall-tree vegetation, and the low undulating topography aid in the ease and low cost of road construction, and footpath tracing and maintenance. The northern sector, on the other hand, is hilly (above 600 meters a.s.l.) and most irregular in topography. (Note that the highest topographical point in Ghana is found in this area.) The vegetation is lush, and made up of trees of medium height. Definitely, these are factors bound to affect the cost and time factors in road construction and foot-path cutting and maintenance.

A binary matrix based on the contact points between the seventy market centres is provided in Appendix IV as MARKSEM. The contact points between these same centres through the available motor road network is also shown in Appendix V as RONEM. The map and graphical illustrations of these contact points are as shown in Figure 3.3.

Generally interpreted, there is the indication that contacts through market networks are superior to the contacts through motor road networks; this cursory observation is based on the fact that whereas there are as many as five 'isolated' nodes in the road network map, there is only one in the market contact graph. Similarly, it can be observed that the level of connectivity marked by the

MOTOR ROAD AND MARKET NETWORKS IN SOUTH – EAST GHANA

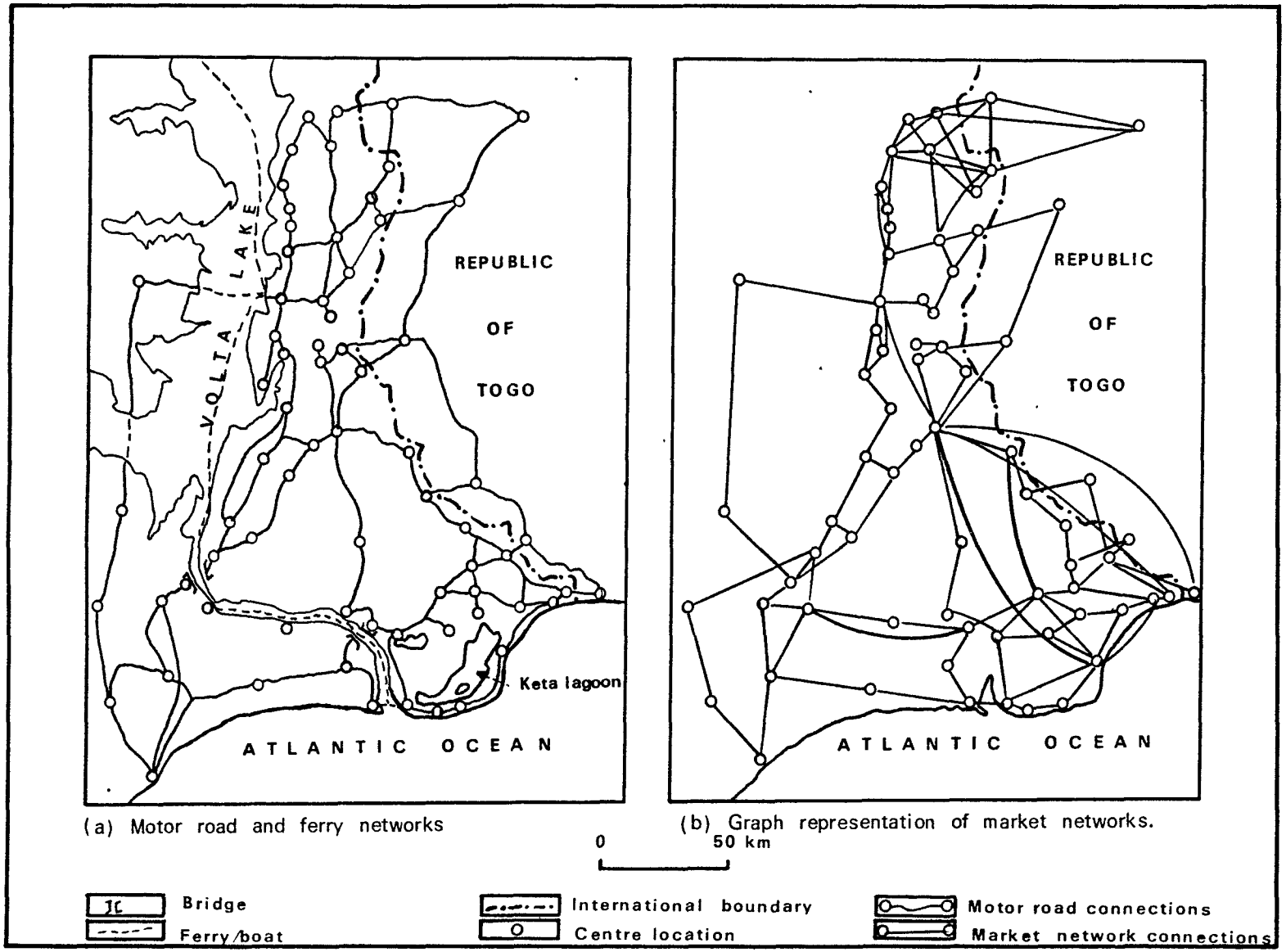

Fig. 3.3 : Map and graph illustration of contact points in South–east Ghana.

criss-crossing of routes in the market network graph is virtually non-existent in the road network map. If we followed the rules of network analysis, this indicates that there are more alternative links for nodes through the market network system than through the road network system(Haggett,1965). This is obvious when comparin comparing link per node for centres in both systems; for example, there is one centre with 13 links in the market system, while the highest per centre for road network system is 5. The link per node index for both systems is compared in Table 3.2; it shows clearly from this table that road network links have a higher loading for 2 and 3 links per node, whereas the distribution in the market network link is fairly spread.The beta indices (Haggett, ibid.) for the two systems show values of 1.4 and 1.7 for road networks and market networks respectively. This means that on the average, one has the option of moving to approximately 1 other centre from each centre in the road network system, and 2 other centres in the market network system. The guidelines suggested by Haggett (1965) for these indices are an indication that movements through periodic market contacts provide a better distribution system than road networks.*

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*Limitations on the indiscriminate use and interpretation of these indices are well-documented in the literature on network and therefore need not be recounted here. For details see for example, Haggett, 1965, chaps. 3 and 8.

Movement through periodic market sequences was drawn as digraphs, restricted by market day sequences. The movements through road networks were derived by finding the most direct route, from the road map of Ghana, between any two centres identified for this study.

For all measures presented here, the shortest distance was defined as in graph theoretic measures, and not in actual distance measures.

TABLE 3.2

SOME CONNECTIVITY INDICES FOR SOUTH-EAST GHANA.

Number of centres with	Road network Graph(RONEM)	Market sequence Graph(MARKSEM).
13 links	-	1
7 links	-	2
6 "	-	3
5 "	2	7
4	6	13
3	25	20
2	31	23
1	6	1
Peripheral nodes (Nodes with only one link)	5	1
Beta Index	97/70 1.4	120/70 1.7
Shape Index	-	3.32

In Table 3.2 is a summary of these indices.

The differences in these results can be interpreted as projecting the role footpaths play in the connectivity of centres within the study region. Although in all areas, distances above 15 kms between any two nodes are undertaken by vehicular transport (including travel by boat in some areas) (see Fig. 3.2 above), the cumulative effects of these short distance movements by the mass of the people through the myriads of footpaths, in order to partake of marketing activities, are significant in ejecting some measure of efficiency in the contact points of place, and by it, the distribution of goods and services within the region.

A final theoretic measure on the connectivity of centres is related to Haggett's formula for the Pi index (Haggett, 1965, p. 240):

$$C/d$$

where C = total mileage of the transport network;
and d = total mileage by the network perimeter.

Since the total mileage of the market network perimeter has been calculated as 1237.5 kms.*, and value for 'C' is 4106 kms. (see distance total in Appendix I), we find that there are 3.32 kms. of market paths for each pair of centres.

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*The inch-marker was used to calculate this figure by rolling it along the perimeter of the outermost link.

3.3 Occupations

As should be expected, the bulk of the population (62.2 percent) is in agriculture (Table 3.3); but only 14.3 percent of the population is into cocoa farming (i.e., export trade of farm produce) 'other farming' which incorporates mostly food crop production is engaged in by 44.5 percent of the population. This interprets that crops produced are marketed either wholly within the region, or within the nation space of Ghana and the adjacent Republic of Togo through the myriads of periodic markets, since there are no urban centres with permanent daily markets. A noteworthy aspect of the occupational distribution of population in the region is the percentage in commercial activities (16.8 percent, which is higher than the national average of 15.5 percent). This figure might even be higher, if we accept the suggestion that some part-time traders may have been categorized under 'other farming'.* The 11.9 percent population registered as engaged in manufacturing represents the large number of local foundry workers, who provide the bulk of the farming equipment in the region. There are virtually no large scale manufacturing establishment in the region. The Aveyime (#40) tannery is yet to take off as a manufacturing establishment, although plans were made in 1965; there is to be established at Akatsi (#51) a sugar-manufacturing industry by 1985 (West Africa, 1980).

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*The 1970 Census was taken in March, a time when most people would be busy preparing their land for the coming farming season. Thus many part-time traders were bound to respond to questions on employment as 'farming' instead of commerce.

TABLE 3.3

PERCENTAGES OF PERSONS IN MAJOR OCCUPATIONS: SOUTH-EAST GHANA VS. GHANA

Occupation Group	South-East Ghana	Ghana
I Agriculture	62.2	59.4
(i) Cocoa Farming	14.3	19.4
(ii) Other Farming	44.5	37.2
(iii) Fishing	3.4	2.8
II Manufacturing	15.0	15.4
(i) Mining and Quarrying	0.1	1.9
(ii) Manufacturing	11.9	9.1
(iii) Construction	2.7	3.5
(iv) Electricity	0.3	0.9
III Commerce, Transport	18.3	19.2
(i) Commerce	16.8	15.5
(ii) Transport & Communication	1.5	3.7
IV Services Services included here are: Technical professions, Administration & Management, Clerical & related Services	4.5	6.0

Source: Adapted from 1970 Population Census of Ghana, Vol. IV.

This virtual absence of any large-scale manufacturing activities in the region suggests that the identification of growth centres for the generation of development would be derived from a simulation of centres with the prerequisites and potentials for agricultural output intensification, and not the industrially related growth-centre programs known the world over.

The place distribution of the major agricultural produce is shown in Figure 3.4. The coastal regions, and areas along the Volta Lake and River are heavily engaged in fishing, although some food crop farming is also undertaken. Noteworthy is the fact that the mid-Volta areas (places around Aveyime (#40), Adidome (#41), and Sogakope (#46) which were once largely fishing communities have 'changed' to animal rearing and/or crop farming (Lawson, 1972). In their place fishing has become important to places like Abotoase (#3), Kpandu (#15), and Botoku (#23) on account of the formation of the Volta Lake since 1966. Cassava (root crop), corn and plantain are grown all over the region, except in the extreme south, where fishing, salt-mining and weaving (of cloth) are very important.

3.4 Summary

The aim of this chapter has been to show that periodic markets play a dominant role in the lives of the population who live in south-east Ghana. Some evidence has been assembled to attest to this aim. Significant among the evidences are that

(i) in terms of the spatial relationship between settlements, almost every miniscule settlement in the region is linked to another through the system of marketers circulating through their rings;

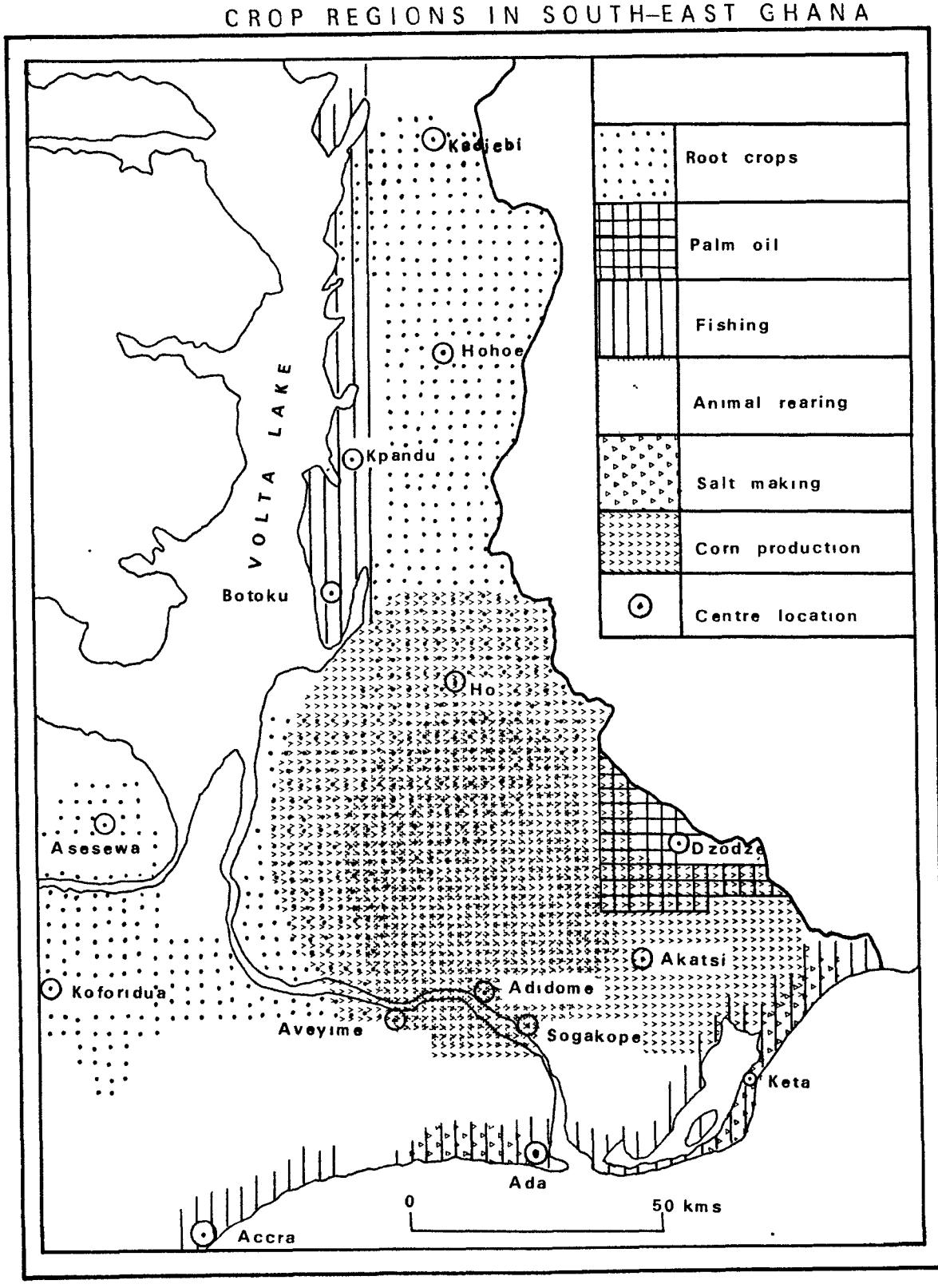

Fig. 3.4 : Areas of major agricultural activities.

(ii) the circulation of crops and services is internally induced and controlled, since there are no export oriented crops, and/or manufacturing activities in the region;

(iii) since by the system of road network, there seem to be too many isolated nodes, and since by their distribution, road networks seem an 'inefficient' contact system for most of these nodes, the potentials of organizing settlements on some roles of periodic marketing are great indeed.

Thus, we can infer that through the market contact network of the myriads of these miniscule settlements, there is an organized and seemingly 'efficient' program for the distribution of, and payment of goods and services.

CHAPTER IV

PERIODIC MARKET ORGANIZATIONAL FRAMEWORK AND THIRD WORLD DEVELOPMENT PLANNING

The purpose of this chapter is to argue that since the thrust of criticisms levelled against the incompatibility of central place theories to periodic market organizational systems was in terms of the economic rationality of behavior and geometric functions of location, there was the need to provide an alternative framework that is superlative to central place theory, especially in terms of the above criticisms. To succintly derive our argument, we trace the source of association between periodic market systems and central place theory in Section 4.1. It is then shown that with the unfolding of research, it became evident that certain serious gaps existed between the predictions of the central place background of explanation and the locational matrix and periodicity incidence of these episodic markets. In the attempt to fill in the gap, periodic market circuits were seen as providing an explanatory framework for the location, periodicity and organizational matrix of these episodic markets. The nature and operation of these circuits are presented in Section 4.2. However, it was to be recognized that the explanation provided by the market circuits framework lacked a predictive background as central place theory provided. To fill in this gap, there was the need for an ideological consideration of the background to periodic market behavior. Since the behavioral patterns were found to present more than economic and geometric functions, there was the need to suggest a

framework that was appropriate for these organizational patterns. The search for the appropriate framework is the purpose of Section 4.3. In Section 4.4, the framework of the autonomous development paradigm is suggested and its parameters considered. To be sure, there were sufficient reasons for the adoption of this framework, an assessment of the nature of periodic market organization is provided in Section 4.5 with a view to comparing this to the central place theoretical background and autonomous development paradigm. In view of the fact that there has been found some points of convergence between periodic market circuits explanatory framework, geographical analytical procedure and autonomous development paradigm, a planning model is suggested in Section 4.6. In Section 4.7, a summary of the chapter is provided with a view to linking the argument to the data to be tested in the next chapter.

4.1 Genesis of a Theoretical Problem

It is common knowledge that attempts at the theoretical interpretation of periodic markets are dated to Stine's study on Korea (Stine, 1962). While the initial study and some of the subsequent ones were primarily concerned with providing an explanation for mobile firms, there was emerging from these latter studies, aspects of periodic markets which defined our present focus. For example, Skinner's study on China, with an explicitly spatial central place framework, suggested that the periodicity features of traditional rural markets could be understood from diverse directions. Two of the directions he expatiated upon concerned the mobile firm and the consumer. For the mobile firm, Skinner commented that "the total

amount of demand encompassed by the marketing area of any single rural area is insufficient to provide a profit level which enables the entrepreneur to survive . . . (but) when a group of related markets operates on coordinated periodic schedules, he (the mobile firm/ entrepreneur) can arrange to be in each town in the circuit on its market day" (Skinner, 1964, 1, 10). This mobility between market centres, it was assumed, guaranteed the profitability and therefore, viability of the entrepreneur. For the consumer, Skinner further showed that "the periodicity of markets amounts to a device for reducing the distance he (the consumer) must travel in order to obtain the required goods and services" [Skinner, (ibid)]. Three problems derived from the above, and which have provided the foci for argument and research concerned first, the delimitation of the functional area(s) within which periodic marketing occur(s) for any set of consumers and traders; second, the spatial location and relations of centres within any functional region(s); and third, the patterns and/or organizational schedules of movements within and between markets by marketers.

To the first and second problems above, Skinner was explicit in his suggestions for solutions. Based on central place theory, Skinner postulated his definition of functional marketing regions on mobile traders, and the aggregate demand functions of consumers. Where there was an equitable intersection of these two functions, there was also defined a locus of points (centres) engaged in the exchange of goods and services (Skinner, 1964, 5). Furthermore, for any set of locations, there existed a hierarchy of places, with the

spacing between the locations defined by the size and functional complexity of each centre within the hierarchical system (i.e., the 'marketing principle' or k=3 system of Christaller's hexagons [Christaller, 1966]). Within the various hierarchies, there is a complement of marketing activities which inextricably links all places into a regular system of centres (Skinner, 1964, 5).

Given this context of the location of centres and the relations of centres within periodic market systems, researches were conducted to test if actual observations confirmed these hypotheses. The results of three such researches are shown in Table 4.1.

One interpretation from the table suggests that variations in the periodicity of markets are accompanied by the spacing regularity of centres; further, these variations in spacing are peculiar to regions. For example, in South Bihar, India, while same day markets were 12.8 kms apart (1975), markets 3-days apart in time were 6.8 kms apart in distance; for the Caspian Littoral of Iran, while some day markets were 21.8 kms apart (1973) in distance, markets 3-days apart were 7.2 kms apart in distance. For Ghana, 3-day markets were 12.0 kms apart and were moreover, randomly distributed (Fagerlund & Smith, 1970, 345). These variations between locational spacing and periodicity have partly provided the basis for the argument that the central place framework does not provide sufficient background to the explanation of the system of place locations within periodic market systems. Justifiably, Bromley and Carol Smith, among others, have counteracted such arguments. The basis of their argument has been that these locational analyses ignored the hierarchical,

TABLE 4.1

Temporal and Locational Spacing of Periodic Markets in Three regions (kms)

Temporal Spacing	South Bihar 1928	South Bihar 1975	Caspian Littoral 1915	Caspian Littoral 1973	Ghana 1970
Same day	21.3	12.8	17.6	21.8	-
One day	12.2	8.8	9.8	11.2	-
Two days	12.8	8.7	10.6	12.2	-
Three days	11.3	6.8	7.4	7.2	12.0*
Four days	-	-	-	-	12.8
Seven days	-	-	-	-	15.1

*Original figures were given in miles; for conformity, these original figures were converted into kilometers by multiplying each distance by a factor of 1.6 (i.e., 1 mile = 1.6 kms).

Source: South Bihar, India: Wanmali (1977): Caspian Littoral of Iran: Thorpe (1978); Ghana: Fargerlund and Smith (1970)

functional and size stratification which Skinner suggested in his explanation of market place locations (Bromley, 1976, 112-119; Smith, 1974, 184-185). Thus, in their estimation, until these conceptual and analytical innovations to the measurement and analysis of market-place locations in space and time were introduced, there should be little expectation of the confirmation of periodic market place locational subsystems within central place theory. In response to these arguments by Bromley and Carol Smith, other researchers have used data from Table 4.1 to suggest the inability of central place theory to satisfactorily explain periodic market locational systems.

As is discernible from Table 4.1, over the sampled region of South Bihar, India, there were in 1928, 94 market places of various periodic and distance intervals; for example, same day markets were 21.3 kms apart and 3-days' apart market places were 11.3 kms apart; for the same region in 1975, the corresponding figures were 200 market places, 12.8 kms apart for same day markets and, 6.8 kms interval for markets separated 3-days apart. This showed that over time, there was an increase in the number of market centres, and this was accompanied by a decrease in the distance interval between market centres of various periodicity intervals. This implied a proliferation of numerous market places, established to sustain the density and therefore the efficiency of interaction between marketers in the study region.

On the contrary, the figures for the Caspian Littoral of Iran indicated that with the decrease in the number of market places from 46 in 1915 to 36 in 1973, there were increases in the locational interval between the various periodicity frequency of markets. For

example, same day markets which were 17.6 kms apart in 1915 were 21.8 kms apart in 1973; and markets of two days' interval, which were 10.6 kms apart in 1915, were 12.2 kms apart in 1973. This implied an increase in the size and functions of some centres in the periodic market system of the Caspian Littoral of Iran with changes in time. The correspondence of these events to Skinner's cyclic theory of market intensification to explain changes that accompany population density and the enlargement and fixity of central places could not be in much doubt.* As an extension to this logic, other authors have suggested that in certain situations, there should be the expectation of less frequent periodic meetings in such market places which become associated with markets for specialized high-order goods. In the end these "centres of still higher orders would, apart from having daily and 4-day periodic markets, go on to have those of 8-day, 16-day and 32-day periodicity, the time interval in this case relating to the market areas of the city concerned" (Mabogunje, 1967, 173). The suggestion here is that in effect, all centres in any region will become linked into a single system of central places, with the dominant centre in a "primate-city' position, and all others in a dendritic arrangement to it (Johnson, 1970).

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*Skinner's cyclic theory of market location involved the assumption that with increase in the size and functional complexity of a centre, there ensued the enlargement of some centres in the system of places; this led to an addition to market meetings (i.e., daily market meetings, and far-spaced periodic meetings), and eventually, the creation of new market places. The enlarged markets ultimately become 'fixed' in location, and thus serve as central places within the system of locations (Skinner, 1965a, p. 209).

Alternatively, Ukwu argued that there should be a distinction between these central place systems for relations in urban places and the relations in 'market place sub-systems' (Hodder & Ukwu, 1969, 152-155). In his estimation, each of these systems is characterized by different institutions based largely on the location of a centre relative to a predominantly urban or rural system, and the functional complexity and technological bias of the system. Thus, while locations in a predominantly urban system have potentials for adopting central place arrangements, market place sub-systems have a tendency to be organized on "extreme fragmentation of social and political units, [and show that] interaction between communities led, not to the development of large centres, but to a proliferation of small ones" (Hodder & Ukwu, 1969, 153) as data for South Bihar, India, have shown.

In view of these divergences in argument and data, it is pertinent to heed Smith's caution that "to construe [any of] this, as a predictable deterministic process is altogether too naive" (Smith, 1979, 484) especially, if it is to be expected that the locational and spatial organizational parameters of periodic market systems are relevant for planning the development of the rural areas of most Third World countries. Thus researchers have been left with unresolved questions on what to expect in terms of periodic market locational and organizational functions as marketing activities increased, and as these market functions become part of the 'modern' world.

The earliest ideas on how to organize such researches could be attributed to Berry, who noted that "if the details of periodicity, commodities traded, and forms of social integration vary culturally, so [would] the locations of periodic markets, [since] all [periodic markets] locate to serve buyers and sellers efficiently" (Berry, 1967, 98). This speculation on the part of Berry suggested many issues, two of which are critical to this study: first, the identification of market centres was the outcome of a deliberate decision, a decision conditioned by a set of factors. Second, the set of factors affecting the decision of location and organization should be thought of as culturally variable, since the concept of efficiency of service varies from place to place. Given this second evaluation, it became clear that the explanation of periodic market location in terms of economic factors not only shifted the attention of researchers from the non-economic factors, but also helped in giving a partial explanation to a system that depends almost equally on the non-economic factors for operation. A documentation of some of these issues, as they relate to the locational and organizational studies of periodic markets and their systems is the focus of the next section.

4.2 Patterns of Periodic Market Organizational Systems

A pretense to a complete knowledge and documentation of the mentality, value systems, beliefs, culture and way of life which periodic market systems have created on the landscapes of specific regions is not the aim of this section. Rather, we wish to briefly document some of the relevant landscape patterns which researchers have deduced from their study of periodic market systems.

A convenient starting point is a classification of market place participants. In a simple typology, Smith (1977) identified full-time participants, part-time participants and non-farmer participants (i.e., full-time traders). Market visitations by the identified groups are for purposes of either selling, buying, or selling and buying as illustrated in Table 4.2.

TABLE 4.2

Typology of Market Place Participants

Participants	Reason for Presence in the Market Place		
	To Buy	To Sell	To Buy and Sell
Full-time farmer	1*	3	2
Part-time farmer	2	1	3
Full-time trader (non-farmer)	2	3	1

Adopted from Smith, 1977, 13

*Assigned numbers denote in descending order, the priority reason for participants' presence in the market place.

Market visitations by the full-time farmer are mainly for the purchase of vital farm inputs and/or imported items needed in a household. These visits are very irregular during the cropping season; during the off-farming season, these visits assume a social and religious role. The part-time farmer oscillates between farm-work and trade in commodities, sometimes other than what is produced

on his farm. In West Africa "in many of the so-called agricultural households the head of the household trades part-time even during the normally short farming season" (Bauer & Yamey, 1951, 745).

The visitation patterns of these part-time traders and full-time farmers have provided the basis for the derivation of market place locations and relations for some researchers. In what has been termed the 'consumer hypothesis'--for these participants have been assumed to be mostly consumers--it has been reasoned that these consumers would visit the markets nearest to their home villages (least travel effort) and from which they hope to purchase the maximum number of goods and services demanded by their households (Smith & Hay, 1970, 5-11). Thus in Carol Smith's estimation, these consumers' itineraries would be conditioned by a knowledge of the periodicity of a given set of market places within their cognitive environment (C. A. Smith, 1974, 182). As useful as such assumptions might be in determining a regular pattern of location of centres relative to producing and consuming centres, other researches have shown that other sets of factors influence consumers' relation to market places within their cognitive environment in determining patterns of location. For example, the Bohannans' study of Tiv markets has demonstrated the importance of the interrelatedness of economic, political, religious and recreational factors in defining the life-styles periodic markets have imposed on the landscapes of that region (Bohannan & Bohannan, 1968, 188). Burrough's work on the Saba weekly *tamu* (periodic market) demonstrated the relevance of social factors in determining the mentality of these institutions (Burrough, 1977, 48-64). Agrawal's

illustration of the interdependence of religious and economic networks in conditioning the value of systems of periodic market places in Madhya Pradesh, India, is another example of the patterns periodic markets could produce in a region (Smith, 1978, 13).

As relevant as these sets of factors might seem in defining the location and relations of market places to each other, with a view to defining functional periodic market regions, frustrations over the inability of the non-economic functions to be generic have encouraged the devotion of attention to trader itineraries which seem to be guided by economic factors.

Non-farmer market participants are normally full-time traders who circulate between market centres within their cognitive environment with the aim of buying goods in bulk from periodic market to periodic market and retailing them at known locations or just any periodic market within their itineraries. A basic principle for determining the paths of these traders has been termed the 'trader hypothesis.' The hypothesis assumes that market visitation patterns are a response to the desire of traders to minimize movement costs (Bromley, 1976, 92; Hill & Smith, 1972, 354). But since for any area, market periodicity schedules are fixed, traders select those markets which satisfy the principle of the hypothesis; thus although traders do not determine the schedules of market periodicities in any area, their visitation schedules contribute to the agglomeration of other traders and consumers in a particular market, and therefore the relation of that market place to other market places in an area. Guided by this hypothesis, it could be said that if there are, for

example, six centres within the circuit a trader plies such that in any market week there are market meetings, the trader then has a visitation per day within the circuit. The resultant visitation pattern for such an area is illustrated for Spanish Morocco and north-east Ghana in Figure 4.1. The schedule for both areas assumes that a traders' itinerary is complete if only he returns to the centre of origin after visiting each of the centres on his itinerary. What this implies is that the trader in the former Spanish Morocco, for example, who starts his tour on a Sunday ('S' in Fig. 4.1 a) moves to a Monday market (M) the following day; on the following Tuesday, he moves to a location that seems farthest from his starting centre (S), but is closer to the Monday market before moving to a Wednesday market (W). Similarly, the trader in north-east Ghana (Fig. 4.1 b) who starts on day 1 moves to day 2, and then 'jumps' over days 5 and 6 to day 2, since locations at days 5 and 6 have their market days following those locations at days 3 and 4. For each of these traders is defined a locus of points which forms the market ring or circle referred to earlier in this study. The ring concept thus denotes the existence of a complete sequence of an integrated set of markets in an area.

The presupposition for these spatial interactions is that at any one time, and for any area, traders (and consumers) are aware of only one other place in a system of places which holds its market day on a given day. The falsity of this presupposition was suggested by Poleman's observation that in Ghanaian rural periodic market areas -

SOME PERIODIC MARKET PATTERNS

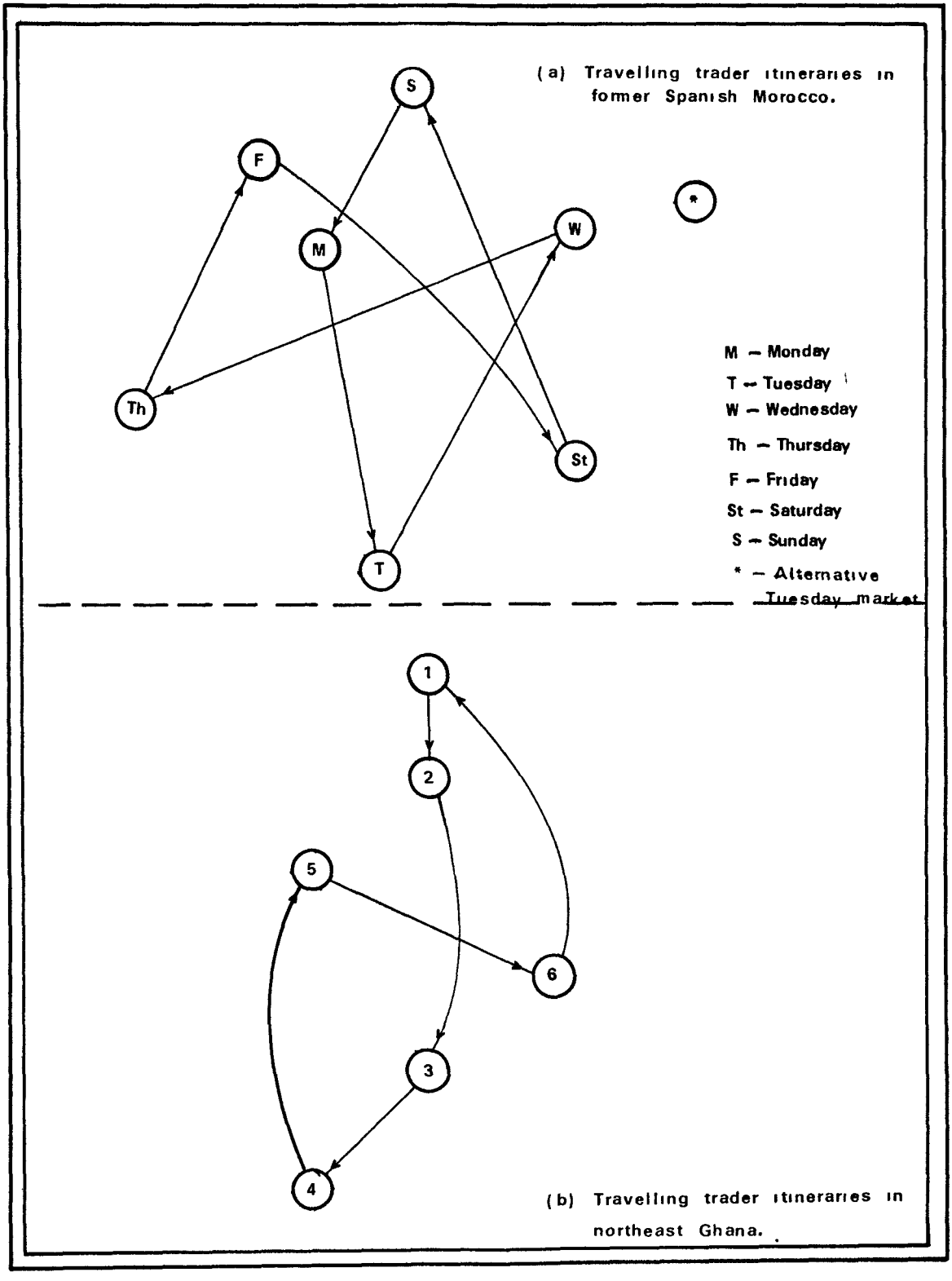

Fig. 4.1 : Simple market ring patterns.
(Source: Smith, R.H.T., 1978, 23)

> most farm people think of themselves not as being served by just one market, but as being near the hub of four or more, each of which is held on a different day. These circles generally overlap . . . [and] the countryside is crisscrossed by a sort of chain-mail of circles. (Polemen, 1961, 62; also Hodder, 1965, 56; Hodder & Ukwu, 1969, 156).

What such observation generated was the delineation of a "group of markets serving a specified area and unified by a known order of shifts" (Alao, 1968, 3). The problem such studies generated included among other things, the pattern of market shifts by which market meetings moved from one market place to another in the light of the decisions marketers had to make as to which market to visit in a given circuit. As difficult as such studies might be for single market participants, researches were conducted with the aggregate of traders from each source location in mind. Given an aggregate number of traders, there could be derived for any centre, more than one route to another or sets of adjacent markets, denoting in effect the actual behavior of the various traders who leave each centre on each trading day to exchange goods in other episodic markets. Given this 'split' in trip generation from some centres in a system of places, it should be expected that "since the markets which will be of interest to the [itinerant] vendor belong to several 'rings', it may be difficult to tamper with the order in which they meet without at the same time disrupting the order of the individual 'rings' to which they belong" (Adalemo, 1975, 21). The aim of maintaining the order of market visitation, and at the same maintaining 'rings' of sequented schedules led to the recognition of some complex periodic market rings. What this produced was the recognition of 'rings' as sub-systems within

systems; the recognition of the sub-systems was based largely on differences in frequency of meetings as is shown in Figure 4.2. For the figure, the dotted lines represent the boundaries between the sub-system of rings; for the sub-system in the left-hand corner of the figure, market meetings are on the four-day schedule, and trader visitation schedules are shown, by the direction of arrows. For the adjoining sub-system to the right, market periodicities are mixed; there are fixed market days in the week (for example 2, 5 and 3,7) and cyclical market periodicities. Between each of these sub-units, there is a link through what was later termed "bridgeheads' (Tinkler, 1973).. These bridgeheads act as important market centres through which goods and services from adjacent cycles are exchanged. While for the two upper circuits in Figure 4.2 two bridgeheads are recognizable, for the upper and lower circuits on the right of the figure, only one bridgehead connects the two sub-systems. The possibility of such variations in the number of bridgeheads existing is conditioned by factors such as variations in market periodicities (as the figure shows), variations in the produce of the adjoining regions, the spatial arrangement of settlements or the level and medium of transport technology available between the cycles.

In extending this concept of market cycles in juxtaposition interacting with each other, Plattner suggested that if the level of exchange could be intensified by increasing demand through either increases in population, or the enlargement of trading area, or a diversification in the nature of goods and services, or a combination of any of these, there could be described for large areas, "multiple communities in dyadic or reciprocal exchange" (Plattner, 1976, 76-77).

SIMPLE AND COMPLEX PERIODIC MARKET RINGS

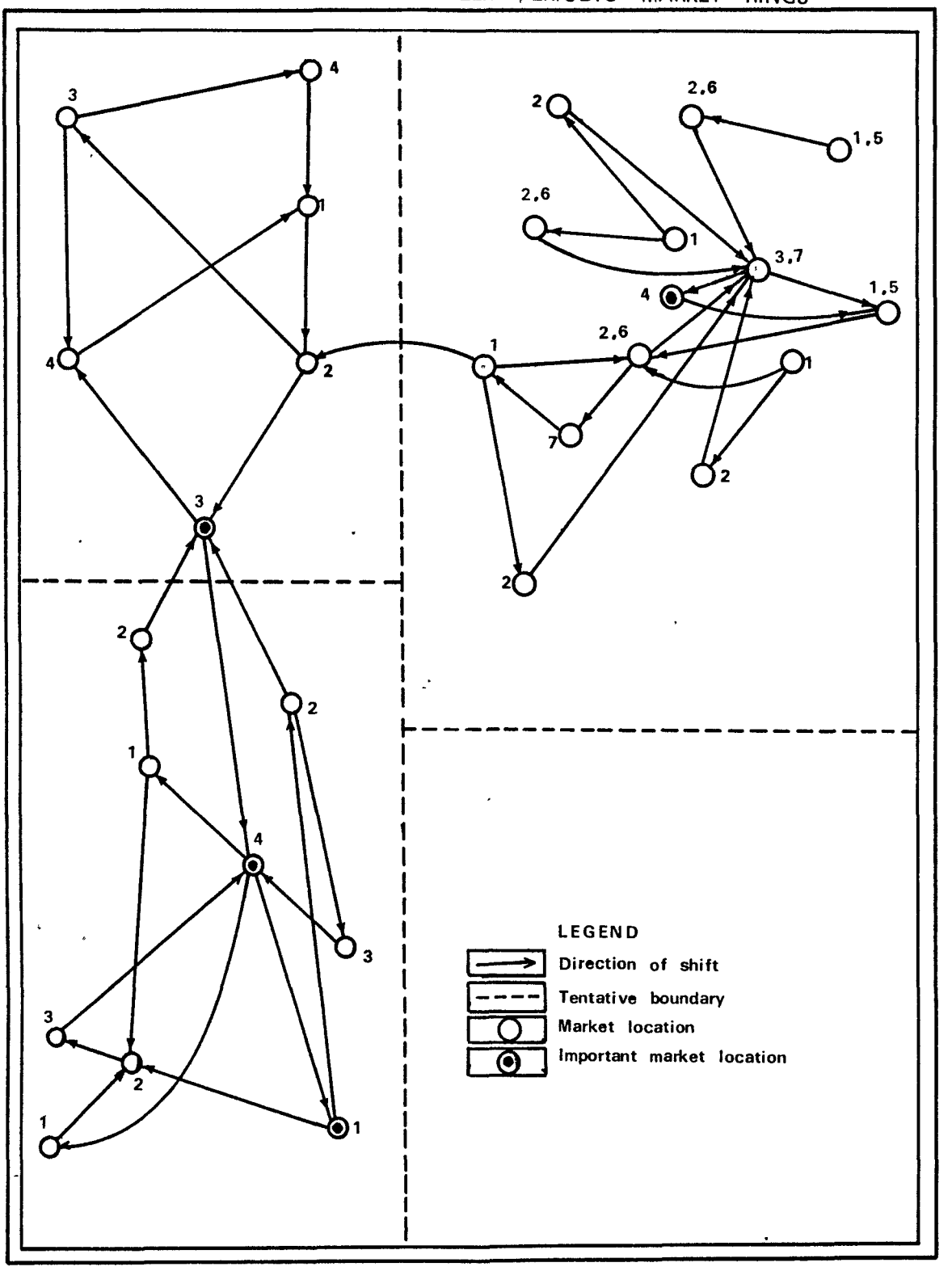

Fig. 4.2 : Circulation paths and market ring types.
(Source : Adalemo, 1975, 22).

What this analysis by Plattner suggested was that if communities in juxtaposition could interact through these circuits described and by it, provide the basis of interaction and cohesion within themselves and between each other, then there could be defined, through such analysis, functional market regions for various communities engaged in periodic market trade. Each such community would have its system of market places structured upon a central market centre which may act as the major market centre, or a number of market centres which may act as central market places and bridgeheads between adjoining communities.

This conceptual development was given methodological significance by Harvey and Brown. Their "market component" analysis suggested that in order to use the concept to define functional market regions (systems) the aim must be that

> total distance or the maximum distance is minimized subject to the constraint that the set of markets meet on sequential days and that a tour can be traced from some "starting day" and finally returning to the start (Brown & Harvey, 1977, 1254-1255).

In demonstrating the ability of this concept to provide a solution to the problems of using periodic market schedules to define the relationship between centres in a system of places, and therefore defining functional regions, they applied the technique to Morocco. The relevance of their analysis to the problems for which central place theory was heavily criticized seems significant. For example, with their system of definition, circuits were defined by known routes of marketers' operation through a system of places. By this system, the analysis does not define the delineation of

regions merely as a space-filling process (as central place systems suggest); rather, the system recognizes the people-serving characteristics of these periodic market places. Thus, by making use of the known centres at which marketing activities are specifically located, there was defined circuits (regions) and articulation centres (central functional locations) which are either 'centrally' located within a system of market places or are links (bridgeheads) between adjoining cycles (communities).

A major conclusion that can be drawn from these studies is that the ideas inhibited by these theoretical market rings and their circulatory paths have potentials of flexibility and adaptability for restructuring the transformation of rural areas in the Third World regions they serve. This idea, whose origin can be traced to Johnson (1970) has met with 'unfavorable' comments; in a recent statement, Smith noted that

> it is of crucial importance that extravagant claims for the potential contribution of periodic markets and marketing to development be avoided (Smith, 1978, 23),

since the contributions of these institutions to various policy problems have not yet been thoroughly researched.

Given that there is no time better than now in guessing at the potential contributions periodic markets could play in the development programs of some regions in the Third World, it is relevant to suggest the possible routes for the debates of such issues. Thus we may ask: Is there a coherent planning paradigm for Third World regions in general? How comprehensive are the tenets of such planning frameworks, if there are any? Do the existing and potential

parameters of periodic market systems suggest any solutions to the design of development planning problems?

In the next section, we highlight some of the salient features of these questions which may help provide probable solutions to the use of periodic market systems in development planning.

4.3 Third World Development Thinking

Third World development thinking is dated to the birth of the United Nations Organization in 1945 (Flores, 1976, 38). Since that time, there have been development 'epochs' and 'decades' during which various programs were experimented with, with a view to deriving a framework that could help accelerate the planning process in the Third World regions of the world. What was started off then as the injection of economic aid into the systems of 'backward' societies in order to push them up into the modernization paths of the type known to the Western World soon escalated into a debatable framework. With its conception and birth premised on economic aid, students of development planning, over the next quarter century, relied heavily on economic planning as the raison d'etre to the modernization of most Third World regions. Under its tenets, development was defined as involving the exploitation of all productive resources within a nation state, with a view to expanding real income above a given datum.

In time, however, concern with the social factors of development planning became obvious. During that time, it dawned on the development mandarins, theoreticians and professionals that purely economic goals could not be separated from their social correlates

(Bernstein, 1971; de Kadt & Williams, 1974). The 'golden key' to development thus shifted from the replication of economic structures and institutions to people objectification with tidy, efficient technological systems. The attraction of the neat structures of growth pole theory became the objective function upon which most Third World countries designed their development paths. The barrage of intellectual criticisms, aided by empirical evidences of failure of replication, encouraged the 'rejection' of the growth pole theory as the solution to the development problems of most Third World nation states.*

4.4 Autonomous Development

After a tortuous and heated debate in the 1970's over what development paradigm Third World nations ought to adopt for a progressive transformation of their space economies, there has evolved what the planning mandarins call "autonomous development," "self-reliance" or "liberation" (Flores, 1976, 37; Mentes, 1975, 90; Adebayo, 1979, 1501). The recourse to this vocabulary is a measure of a vigorous self-defense, aimed at circumventing the structural replication of former paradigms, and rather stressing the role of similar processes in generating development; whatever structural systems may result from these similar processes are functions of

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*Among the more important citations to support the arguments for the failure of growth pole strategies in Third World countries the following may be mentioned: Conroy, M. E, 'Rejection of Growth Centre Strategy in Latin American Regional Development' Land Economic, XIIX, 4 (1973), 371-381; Darkoh, M. B. K., 'Growth Poles and Growth Centres with Special Reference to Developing Countries--A Critigue' Jrnl. of Tropical Geo., 1977, 44, 12-22.

place and time*, since "there is no universal (structural) spatial model for all countries" (Prion, 1970, 256).

But what is the "autonomous development" paradigm about? Are its themes entirely different from paradigms that have preceded it? Are its themes logically related to the develoment problems of most Third World nations.

In order to succintly interpret the major themes of this paradigm, we need to define in general terms, the meanings "development" assumes in this context.

First, development is considered as a generalized evolutionary process, seeking the transformation of the entire way of life of human collectivities, and the full range of conditions under which they live. As an evolutionary process, it is assumed that its continuity is derived from the historical dimension of society; but, since not all historically derived processes of all societies have demonstrated capabilities of transforming societies constructively, development theoreticians have assigned to this paradigm, a three-dimension psychological frame as a necessary condition. As defined by Fred Riggs, the set of forces are self-determination, systematic viability, and the ability of a society to recover from set-backs (Weintraub, 1972, 7). A harmonious and simultaneous operation of these forces is critical to the initiation and sustenance of this

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*As in physical geography, for example, the identification of the universality of processes is almost always made paramount in research. The effects of differences in place and time are then programmed to be reflected in specific places. It is this observation which has been extended into human geography, and is being echoed in this argument.

evolutionary process of development. A second parameter of the autonomous development paradigm connotes the "entire gamut of changes by which any social system moves away from a condition of life widely perceived as unsatisfactory towards an alternative condition held to be 'humanly' better"* (Gouiet, 1971). The inference is that a development unit, by randomly or constantly reviewing its performances in terms of the entire gamut of life would, at some point, very likely begin to identify some need for changes, which might be deemed better than past and current conditions of life. In an effort to chart new directions and dimensions of life, societies may wish to adopt paths charted by some other societies in the past, and/or adopt some normative routes.** What the autonomous development paradigm defines, however, is the ability of directed changes to be philosophically attuned to the needs of given cultures. The condition to development in this context is, therefore, not a mere desire and choice among tested past programs of other places for replication in another unit; rather, it is a choice among alternatively derived routes, with a view to adopting dimensions of change sufficiently relevant to conditions of the given society in the process of change. Thus the necessity of development assuming normative and philosophical dimensions which a society has

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*The philosophical undertones incorporated in this definition are too intricate to be argued out at this level of discussion.

**The history of routes adopted by most Third World regions has shown that most of these societies opted to, or were coerced to chart their development programs by a replication of the events which helped the materially advanced countries to develop. A terse commentary on these paths can be found in de Souza, A. R., and Foust, J. B.: World Space-Economy (1979), Chapter 10.

found to be compatible to its given conditions are crucial to the definition of this paradigm. Third, development under the self-reliance paradigm defines a distinct set of agents which acts according to, and in the spirit of the preceding definitions.* Three specific kinds of agents mentioned by Friedmann for this kind of development are intellectuals, administrators and entrepreneurs (Hilhorst, 1971, 18).

What we infer from such a definition is a spontaneous realization by, and conscious effort, on the part of a society to chart a course of positive movement from one state to another. An evolutionary movement of this type is not something that can be fashioned out or created quickly. But as Johnson pointed out, "although it cannot be devised at will, its emergence can be hastened by planning and wise policies" (Johnson, 1970, 18). Within the context of the autonomous development paradigm, such policies have to be guided by the value systems and the perceptions of the needs and resources of given space regions. In the attainment of the identified policies, the planning objectives ought to be geared towards the release of the latent energies of the given societies, and the galvanization of such energies through their interaction with material resources and the intervention and application of the appropriate technology that can sustain the present needs of society, as well as inhibiting potentials for the containment of future transformations. What such a program requires is setting in motion a development process that is flexible to given

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*This has been a summary of definitions adapted from Flores, 1976, 29-30.

conditions and needs of named societies, without necessarily softening the discipline or process rigidity that goes with development.

In sum, self-reliant development argues for the need to structure the processes of development upon the known and potential needs (resources) of the named society with a view to generating spatial structures that are germane to the organizational capabilities of the society. In effect, development, if it does take off, must be people serving, especially the people involved directly in changing the resource base of the region.

Given the above framework of an explanation for development planning, can it be said that the theoretical explanations available for the systems of market places are capable of being fashioned for the development of some places in the Third World? What, if any, are the points of convergence between the theoretical explanations of periodic market systems and the autonomous development paradigm? Are such referent points potentially more resilient than the framework provided by central place theoretical explanations? We attempt answers to these questins, starting from the last, in the next section.

4.5 Correlates Between Periodic Market Theories and Autonomous Development Paradigm

Of the numerous criticisms levelled against the use of central place theory in explaining the relations of places within any system, three relevant ones are discussed here, as providing sufficient backgrounds for the inability of the theory to explain periodic market place systems' relations. First, central place

theory, in explaining the relations between places in a system postulated that these relations were tied primarily by an economic function which was defined by an economic demand per unit area. This economic demand function was derivable either from the point of the consumer or supplier: for the consumer, the major sources of satisfying this demand function was a dense population, a fair amount of disposable income, and relatively easy and cheap mode of transport movement. For the supplier, the major economic constraints were travelling costs, overheads and viability. For the economic demand function to be satisfied for each sub-system, central place theory predicted a spatial location of points in a fixed ratio, since that was the best possible way to sustain the viability of supplies in any system, and also to maintain the demand density for places. What was shown for periodic market theories of location was a fixed set of meeting days. From these schedules, traders and buyers were to define their sequence of visits. Thus for these market place systems, there could not be expected any regular hexagons of place locations. The implication then is that while market place circuits were established to serve people, central place hexagons were made mainly to 'fill-in' spaces. For the autonomous development paradigm, this meant that for any market circuit, there could be designed a variety of spatial structures; structures which might be in tune with the philosophical innuendoes of each system; and structures that might satisfy both economic and non-economic functions of a system; and structures that might be wary of the level of transport development in any system.

A second criticism of central place theory, relative to periodic market locational problems concerned the size and functional complexity of places within the system. Central place explanations predicted that for any system of relations, there existed a hierarchy; relations between places of the same hierarchy and between one hierarchy and another varied from the function the region performed. The location of such centres in a hierarchical form was defined by a k-system of relations. Evidence from the theories of periodic market locations have projected that these loose chain-mail relations between exclusive groups of markets seemed to characterize the relations between places within any system. While the existence of hierarchies of centres have been shown to exist, there is as yet to be shown a fixed location spacing, or a fixed set of reasons for the locational designation of such centres. As shown in Figure 4.2, major market locations could be found serving a specific region wholly, or be located between sets of circuits. Assuming that such major market centres were derived by the number of visitations to it or the range of goods available on a market day, it could be argued that as other centres within any system increased their complexity in terms of these function, they could attract a larger number of marketers. As data in Table 4.1 have suggested, such assumptions are possible; such that any place could compete with any other in a system of places and become more viable than others. What such assumption suggests is that given some impetus for competition, any system could possibly become what it potentially could.

A final point of criticism concerned the implied assumption in central place theory that all places and all systems were related to,

and dependent upon a common technological mode of movement and production. Thus in empirical studies with such theories, one commonly used definitions of mean distance and actual distance to find what travel effort was needed by buyers and sellers to buy or dispose of their goods and services. Such definitions helped in determining travel costs for sellers within a system of places. As was shown for the theories of periodic market circuits, while the consumer and trader hypotheses could help researchers to define the possible market centres to visit, the greater role non-economic factors play in the maximization of travel effort by consumers especially introduced an almost impossibility of relying on such measures. What this implied is that in view of the differences in the mode of transport travel by consumers and traders to buy and sell their goods, economic rationality did not always define the patterns of location within any system of places. What defined the patterns of market visitation (and therefore location of complex functional places) was a combination of factors not excluding the spatial structure of settlements, the history of places, the modes of movement between places, impacts of colonialism, the profit motive of some traders, the culture of taste (diet), and religious affiliations among places, among a host of others, as they act to define for people in a space region, a cognitive map of exclusive markets which they could visit in a market week or market month.

As inconclusive as current studies on periodic market systems in general are, and as undeterministic as any of these factors are in generalizing for the locational patterns of centres in a system of

periodic market places, it is relevant and logical to note that more detailed studies with micro-scale data would be relevant in defining the major variables at work in defining locations as well as relations in a market place system. But as has been proposed above, can such studies help in an understanding of the organizational capabilities of these places given that these systems have existed in these environments for so long without contributing to their development?

Correlating the state of objectives and processes towards which autonomous development planning have been formulated, and the parameters around which periodic markets have been shown to be scheduled, suggestions could be made to offset the argument that periodic markets as "primitive markets . . . are essentially indigeneous institutions in which customs and traditions have been handed down from generation to generation" (Olivieri-Rodriguez, 1961, 49), and, are therefore not potentially amenable to development planning in modern times. The first of such suggestions is a derivative of the argument that 'modernization theorists' of the Western origin and their elitist disciples in most Third World regions have always characterized various operationable systems in the Third World, and the values they exhibit in very 'derogatory' terms (e.g., informal sector of periodic markets, peasant and primitive societies, et cetera). The psychological effect of such jargons on the minds of most researchers has been not only a tendency to discard the systems epitomised by such nomenclatures, but also to avoid researching them thoroughly. Logically, such systems become the focus of study by first, anthropologists, and second, some 'revolutionary academics.'

The interests of other academics are aroused only if substantial material has been accumulated to prove the organizatonal potentials of such systems. This has been the lot of the study of periodic markets. With the accumulation of material on the system it is becoming evident that not only are these miniscule centres of importance to the internal trade of the places they serve, but more importantly, that they are manifestations of the links and bondages between places in economic and non-economic relations.

A second suggestion is that the objectives of the autonomous development paradigm provide the right incentives and focus to the fashioning out of these traditional systems the normative structures required for the development of some Third World regions.

An extension to this argument worth stressing is that the development framework within which most Western nations 'took off' was not initiated do novo. It is common knowledge that it was by a careful monitoring of the essentials of the traditional systems of these places that there evolved their known development strategies. To argue therefore that the traditional systems of these places were discarded before any development took place will be a turn around on the course of the history of development.

As an iteration of the above suggestions, it need be argued that shifting a development strategy towards traditional frameworks does not necessarily denote a return to a dead past. History is not static; its timelessness should therefore be utilized as a positive factor in the blend of events for future improvements of places. As eloquently expressed by Cesaire, no society, intrigued by the forces of development would opt

> to make a utopian and sterile attempt to repeat the past, but to go beyond. [For] it is not a dead society that we desire to prolong . . . [rather] it is a new society that we must create . . . a society rich with the productive powers of modern times [but] warm with all the fraternity of ancient days. (Aimé Cesaire, 1972)

By a recourse to such blend of events in a system, a society would be planned to become what it can potentially become through the engagement of the free will of its people.

4.6 Planning Model with Periodic Markets

The summary conclusion we have charted so far assumes that periodic market systems have some bases of being utilized for development planning problems. What need be done then is to relate the basic issues of periodic market circuits to their related planning problems with a view to adopting and/or modifying relevant planning models to the problems of this thesis.

On recapitulation, we note that the spatial problems of periodic market circuits involve the creation of 'exclusive' groups of market places; these groups of market places must be shown to be those centres for which marketers in a circuit have a cognitive knowledge of having a known schedule of market days on particular days. Within these circuits, marketers freely circulate on the scheduled days to make their purchases of goods and services given the mode of transport technology available. An aggregate effect of the travel habits of marketers is the identification of some centres as 'important market centres'--i.e., markets visited by the largest number of marketers from within a circuit, or sets of adjoining centres. These important market centres might be located either within identified circuits or on the boundaries of two or more circuits, giving rise to what are

termed bridgeheads. The essence of these market circuits is that they must relate the actual visitation paths of marketers such that the defined paths must be seen to be serving the demand and supply functions of the people defined by the exclusive sets of market places.

In term of problems in geography, the issue involves the creation of functional regions or sub-regions; each such region must be shown to exhibit some base or bases of coherency, and therefore existence. But more than defining isolated sets of sub-regions, each unit must be shown to have some relationship with adjacent units through some defined channels. What this implies is that although in aggregate form, all centres have a unit of bondage, the scale factor of analysis enables an identification of sub-units within the system of places being studied. The ultimate goal of such analysis of relationships in sub-units enables a determination of networks and patterns in the organization of periodic market paths in a region. From the recognized patterns, there might be the generation of alternative patterns, if need be.

What these problems imply for the autonomous development paradigm is that the identified functional sub-regions must be interlinked by a sales and payment system organized around periodic market systems; for each functional sub-region (circuit), there must be an identified number of centres from which the distribution of goods and services is achieved in accordance with consumer and production preferences generated from within each circuit. The ultimate purpose for the identification of these functional circuits is to attempt to design an increase and/or diversification of the

specialization impetus of each unit. This goal must be organized with local resources and potentials in mind, since a test of such goals is the character and level of community ideology infused into each circuit, given the base of available resources.

In sum, the problem for a model involves basically an analysis of the current structure of periodic marketing and market places in south-east Ghana. What is expected from such analysis is finding some patterns of relationships from within and between sub-units in the region; the relationships of the derived patterns of periodic market organization are then considered in terms of the principles of Third World development planning in general, and the similar problems in Ghana, in particular. The ultimate goal of such analysis and comparison is to attempt to design a consistency in program between how the region is organized in terms of periodic market trade, and how it could be organized in terms of the available and potential resources.

Given the above, the simple model in Figure 4.3 is suggested as a guide for the analysis of data in the next chapter. What the model involves is a planning framework divided into three related stages (i.e., Stage 1, Stage 2, Stage 3). Stage 1 involves an analysis of data with the view to deriving some network patterns in the study region. In order to attempt such analysis, there need be identified some centres from which trips could be generated in order that some sets of centres could be included in a circuit (i.e., Stage 1a--trip generation). The guide for the designation of tours must be the sets of points which define marketers' cognitive environment.

MODEL FOR ANALYSIS OF THESIS

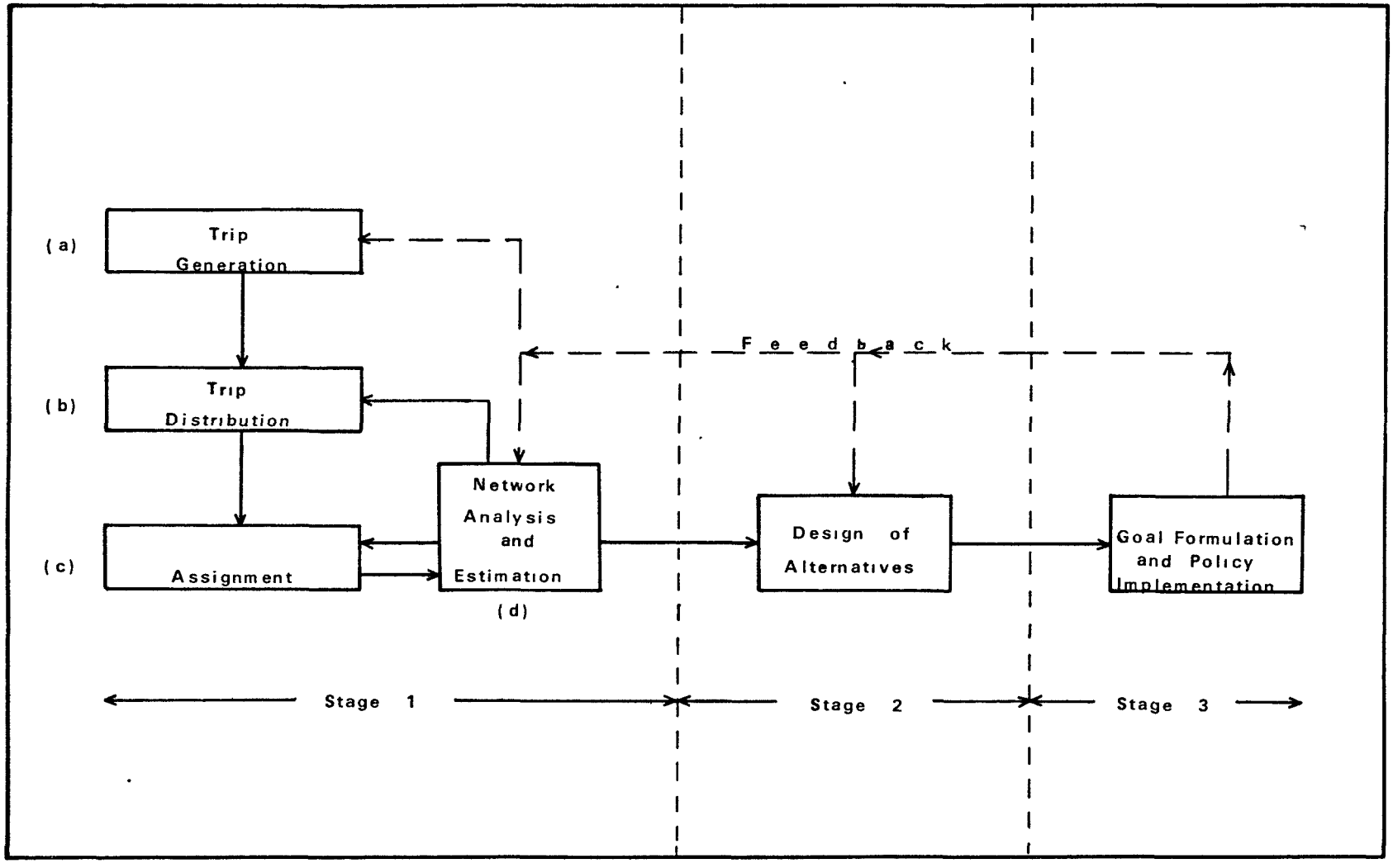

Fig. 4.3. : Planning model for Thesis.

From each of the identified centres must be found some parameters for the determination and distribution of market visitation paths to all other centres in a centre-to-centre movement. Such determination and distribution of paths show the relationships between centres in a circuit, given the parameters which define these tours (Stage 1b--trip distribution).

Given the factors and determinants of the circulation paths of marketers, movement schedules are assigned in a centre-to-centre manner until all possible centres are included in sets of circuits (Stage 1c--assignment). From the derived circuits, we can then analyse the role of, and the relationships between centres in the system of market places in the study region, as well as the determination of the relationships between circuits (Stage 1d--network analysis).

It is the expectation that from this point of analysis, a structural form of periodic market networks in south-east Ghana would have been derived; in cases of failure to find any structural form, the parameters and determinants of trip distribution (1b) and assignment (1c) may be reorganized (feedbacks). While this analytic stage provides the basic focus of the thesis, as a follow through, suggestions are made on the implications of the derived patterns for planning policy in Ghana (Stages 2-3). Given this policy framework, there might be the need for the reorganization (Design--Stage 2) of periodic market places. Such feedback, if it involves considerable changes in network structure, may cause a redesign of the system of places, including this time, even the sources of trip generation (1a). The dynamism of change, if it persists, will involve a cyclical reorganization of the system over time.

4.7 Summary

The aim of this chapter was to argue that from the criticisms levelled against the use of central place theory in explaining the location and network of periodic market places, there was the need to provide an alternative explanatory framework. What was proposed, was a deductive explanation of the system of market places. In order for this alternative explanatory framework to provide a background that could help project future trends of market organization (which might help in planning the development of the areas in which periodic markets systems are a way of life), there was the need to provide an ideological perspective as the central place theory provided in economic and geometric terms. In view of the available theories of development, especially in the Third World, the autonomous development paradigm was suggested as providing a framework that was deducible from the organization of events in the Third World. In searching for the points of convergence between periodic market organization, geographic analytic perspectives, and autonomous development ideology and methodology, a cyclical model of planning was suggested that could help an understanding and explanation of periodic market systems, as well as help in the generation of planning the development problems of the rural areas of the Third World.

In the next chapter, an analysis of the network system of periodic markets in south-east Ghana is pursued in terms of available data and logic.

CHAPTER V

DATA CHARACTERISTICS, MANIPULATION AND ANALYSIS

The argument in this thesis so far has been the suggestion that the spatial organization of space for development planning in parts of the Third World requires initially, a structural analysis of the dominant and/or manipulable systems of given regions, with a view to inducing, from these dominant systems, some parameters which are amenable to stated development programs. A critical requirement of any such development program, it has been argued, ought to be the designation of what a society can potentially become through the manipulation of the known resources of that space region.

Given this focus of an argument, and the environment of south-east Ghana, which has been illustrated to be dominated by an integrated link between agrarian occupations and an intensive internal circulation of surpluses from these occupations, we wish, in this chapter, to manipulate available data with a view to building up some 'resource regions' derived from internal trade relations in that region.

To achieve this aim successfully, this chapter is divided into four main sections in addition to a summary one at the end. In Section 5.1, we attempt a trace of the convergence points between our analytical framework--graph theory and periodic marketing systems. Section 5.2 is devoted to a definition of the objectives

of the analysis and the limits within which data have been set. In Section 5.3 is a description of the stages of the analysis in a logical sequence. The results of the analyses and their implications are presented in Section 5.4.

5.1 Development Planning, Periodic Markets and Graph Theory

In our analysis of the dominant structures of the space region we are studying, it has been pointed out that periodic markets play a critical role in the relations of place, people, goods and services. As such, we need to denote the critical areas in which research in spatial terms of periodic market systems have been carried out.

The geographers' search for the patterns of the spatial structural systems which periodic markets exhibit has been illustrated by Tinkler to be in the determination of "the articulating effects of major market nodes on the intermarket connections generated by individual market trips" (Tinkler, 1979, 99). Tinkler argued further that the search for these articulating effects are capable of being translated into graph theory as a search as to "whether particular nodes acted as cutpoint sets for [a] market system" (Tinkler ibid.) As characteristic as such searches have become, it is not surprising that many researchers of the problem have manipulated data in these terms. Thus we find in Harvey et al (1974), and Brown and Harvey (1979) for example, a pursuit of the theoretical limits and assumptions of these cutpoint sets as are based on the various heuristic algorithms derived from graph theory. In an earlier explanation (Section 1.3), we noted that as

useful as these algorithms have been, the search by the authors for a mathematically consistent program proved to be one disadvantage to their analysis of events as they did exist in southern Morocco. In this analysis, we wish to integrate parts of the program used by these authors with micro-level data from south-east Ghana; these data were representative of events as they did exist at the time of data collection.

5.2 Objectives and Propositions

Derived from the model of operation in Figure 4.3, the objective of this analysis is the determination of the closest knit of relationships between marketing centres in south-east Ghana as these give rise to the fewest number of market circuits; the nature of these relationships as it showed the patterns of links between the derived circuits was also to be pursued. From such analysis, there could be the expectation of finding market centres which might be organized to become important market locations for various development programs in the study region.

Given the above objective, the scheduling of tours as in a travelling salesman's problem is a necessary heuristic for the analysis; but a modification of the classic travelling salesman problem which will require a number of salesmen operating within the system of places at the same time is required. The chromatic travelling salesman's problem thus becomes a more useful heuristic for the analysis. This heuristic is defined as "finding the fewest number of salesmen such that every [node] is visited by a salesman and the length of each salesman's tour does not exceed a specified

constant" (Harvey et al., 1974, 37).

In view of the fact that from the field research there have been found defined schedules of routes linking all places as shown in Figure 5.1, all salesmen's tours throughout this analysis would be based on this schedule. These defined routes and links would thus become the bases for trip distribution and assignment. Given the objectives of the analysis, and the defined routes shown in Figure 5.1, the following propositions were adopted; each proposition related to each step of the model in Figure 4.3.

As was shown, the model consisted of three sub-models concerned with trip generation, trip distribution and trip assignment. Generation was a generic term used to describe the centres from which some defined values of the relationships between the following observations were found:

(a) number of marketers present at a market place on a market day (Appendix 11, column 7)

(b) the population at each centre (Appendix III)

(c) the 'net vertex' indes for each centre in the system of places (Appendix II, column 6); and

(d) the centrality index for each centre (row sums in market sequence matrix, Appendix IV).

Thus in this first part of the model, there was a prediction of the number of salesmen (circuits) expected in the study region. Given these trip generation points, it was proposed that each centre within a defined limit to each of these trip generation points (or source locations) be linked to it and to others at least once (i.e.,

SOUTH – EAST GHANA : PERIODIC MARKET CHARACTERISTICS.

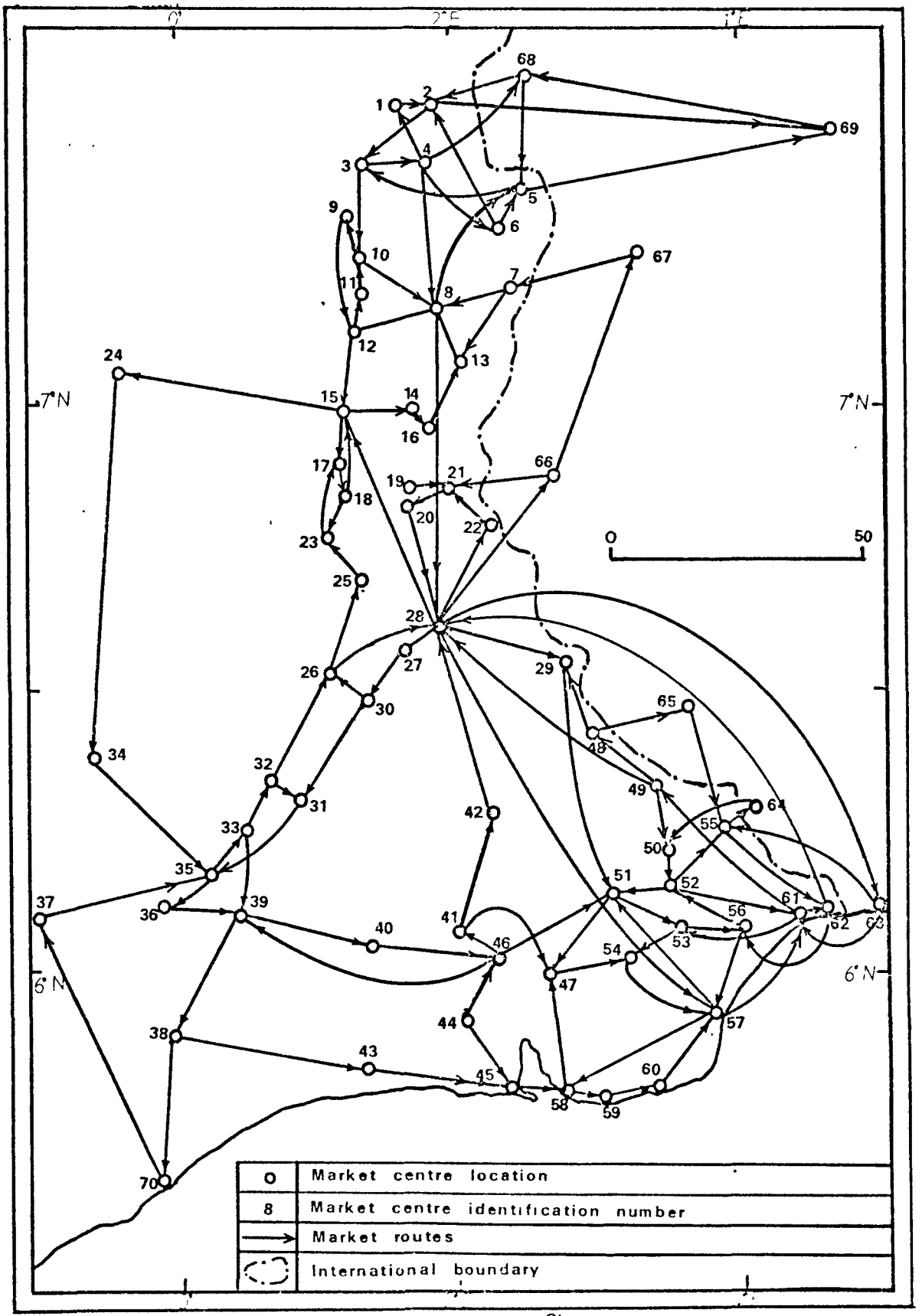

Fig. 5.1 : Market sequence links in south–east Ghana.

each centre within limits to be defined at the subsequent stages of the model, be visited at least once by a salesman from each of the source locations). The upper limit on the number of times a salesman could visit a centre was however infinite. Furthermore, since each salesman must not 'disappear' at the end of his visits, each tour must end where it started. Given the constraints of the 4-day market cycle for the region, these tours may end on the 5th, 9th, 13th, 17th, 21st, etc., etc., day from the first day of a market day at a centre. For the purposes of this study, the additional constraint was imposed that for a circuit to be closed, the salesman must return to his source location on a similar day as the one on which he started (i.e., Monday, ——— Tuesday, ——— Wednesday, ——— . . . , Monday.)* In effect, there must be seen to be completed an equivalent of 29 step-wise movements, or a connection of not more than 28 visits within each salesman's circuit.

For the trip distribution sub-model, data would be manipulated from the trip generation sub-model above to define relationships between each source location and all other centres in the study region. Given these relationships, it was proposed that each salesman visit one market centre on each day. Thus even where a salesman might complete his marketing activities very early at a centre, he

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*Apart from the purposes of this study, it is relevant to note that this constraint conforms to the calendar schedule of the local people in the region. Each calendar month, which corresponds to a farming activity in the year, lasts for 28 days as shown in Appendix VI.

cannot visit any other market centre on the same day.

In the assignment of trips sub-model, salesmen's tours would be guided by

(a) the defined tours in Figure 5.1

(b) the relationships between centres derived from the sub-model on trip distribution. Specifically, it was suggested that since each centre was designated as 'GENERATOR' and 'PARASITE' (see below) and the assumption for such analysis was that a salesman went around distributing and re-stocking his produce at a cost, the constraint was applied that at least once in every 7th step, a salesman visit a 'GENERATOR' centre to restock in order to continue on his rounds (i.e., at least 4 GENERATOR centres in every circuit). Where a salesman visit two or more GENERATOR centres consecutively, it is assumed he increased the bundle of goods and services available to him, and not the total volume of goods.

(c) the fact that not more than one salesman be present at a centre on a marketing day (this however was allowed on a non-marketing day, if possible).

(d) distance and time relationships between centres in the study region. Since from the calculation of the mean of travel time and travel distance, it was found that these were 70 minutes and 35 kilometres respectively (Appendix I), it was suggested that for each circuit, total travel time may not exceed this average over the 28 centres to be visited (i.e., 28 x 70 = 1960 mins.). Similarly, total travel distance for each circuit must be 980 kms (i.e., 28 x 35 km) ideally.

From the above objective and propositions, it was known that the analysis has solutions in some form of operations research. The related models from operations research from which the analysis found solution paths were linear programming, the transport model and a location-allocation moded (Taylor, 1977, 305-6; 312-335). For this analysis, we derive relations from the transport model variant of a location-allocation package (LAP) to suggest proximal solutions for the trip distribution sub-model, and a linear programming model for the assignment sub-model. The procedures are shown in the next section.

5.3 Step-by-step Analytical Procedure

Trip Generation Sub-model

As stated in the previous section, the trip generation centres (source locations) would be derived from a manipulation of some combinations of the following observations:

(a) number of marketers each centre holds;

(b) populations at each centre;

(c) 'net vertex' index for each centre; and

(d) centrality index for each centre.

To simplify the analysis, these observations were grouped into two: an 'attraction factor' and a 'centrality-circulation factor.' To derive the attraction factor, we related the number of marketers at a market centre to the total population at that centre,' and converted this relation into a percentage index (i.e., $\frac{\text{number of marketers}}{\text{total population}} \times 100$). From an analysis of the range of

indices derived from this calculation, a mean was found. Using this mean of 6.5% as a base, the percentage indices for all centres were grouped into classes as shown in Appendix VII, column 1). For the derivation of these interval classes, we assigned to all classes greater than the mean range (i.e., 6.4 - 6.6), scores ranging from 1 to 4 (column 2, Appendix VII). The reason for the assignment of positive scores being that, since these percentages were greater than average, their centres were likely to attract more centres than the normal for other centres in the study region. Class ranges below this mean range were assumed to have an opposite reason of the above, and were therefore assigned negative scores, ranging from -1 to -3. In order to simplify computations at the computer programming stage, all scores were converted into ranks in the following way. All classes with positive scores were assigned a '10' value, and those with negative scores were assigned '20' values. To maintain the differences between the various score ranges, the score of each class range was added to its assigned rank as shown in Column 3, Appendix VII. Thus, an attraction factor class range of 0.0 to 2.0 which had a score of -1 now assumed a rank of 21, denoting for the analysis that among all other centres, it was the least 'attractive' centre a salesman might wish to visit, all things being equal. For the class range 19.6+, a score of 4 assumed a rank of 14, denoting that it was the most 'attractive' of places a salesman might wish to visit to trade in or buy goods and services.

The above procedure was adopted for assigning scores and ranks to the centrality-circulation factor but with a slight modification.

The centrality-circulation factor was derived by manipulating data for the net vertex index and the centrality index. The centrality index was used to define the number of links each centre has within the system of places shown in this study. In this instance, it was expected that the higher the number of links for a centre, the better was that centre linked to other places in the system. Thus, for example, (Ho (#28) which has 13 links showed the best central location; and, Amedzofe (#19), which has only one link, was the least central and accessible. From the range of indices (row sum in Appendix IV), a mean value of 3.6 was calculated, indicating an averagely accessible centre was that which has 3.6 links. From this value, all classes were derived as shown in column, Appendix VIII.

The net vertex index was used to suggest a demand (v+) and supply (v-) function for each centre. The calculation was derived from the graph analysis of connections in Figure 5.1, and which was built into columns 4 and 5, Appendix II. The scheme was that, where there was a convergence of a link on a centre (shown as digraphs in Figure 5.1), there was assumed to be a demand for goods and services from that centre,* and a 'v+' notation assigned. On the other hand, where there was a divergence of a link from a centre, there was supposed to be a supply of goods and services from

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*These designations were derived from an illustrative study by Campbell and cited as one of the works consulted in the bibliography.

that centre*, and a 'v-' notation was assigned. For the net vertex index, therefore, there was a deduction of the demand function (v+) from the supply function (v-) [i.e., (v-) - (v+) = net vertex index]. The reason for this arithmetic was that since the objective was to find the centres that could generate some goods and services into the system of places for purposes of trading, it was ideal that we found an arithmetic that could ensure the generation of 'surplus' rather than a 'deficit'. Thus, for example, Hohoe, (#8) which has 4 links converging on it [(v+) = 4] and 3 diverging from it [(v-) = 3], has a net vertex of -1, indicating it was a centre that has a higher demand for goods and services from the surrounding centres, than it supplied to them. From these net vertex indices, it was assumed that a centre that has a value of '0' was a good medium for the generation and transmission of goods and services within the system of places. Thus, this zero value was assumed as the 'mean' value for this observation; centres which showed positive values above this mean, were assumed to be good marketing sources.

To assign scores and ranks to the centrality-circulation factor, a combination of values from these two observations were taken. It was assumed that a centre that showed mean values on a combination of these observations must be an accessible (centrally located) centre as well as a good marketing centre; centres with values above these mean values must still be 'better' marketing and

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*These designations were derived from an illustrative study by Campbell and cited as one of the works consulted in the bibliography.

accessible centres. They were therefore assigned scores ranging from 1 (for the mean) to 9 for the 'best' in the system (column 3, Appendix VIII), other things being equal. The corollary was assumed for the negative values on the net vertex and values below the mean for the centrality index. The relation between score and rank was the same as for the attraction factor above.* Given the assumptions for the determination of scores as above, all centres which showed ranks in the '10' index were ranked as 'GENERATORS', denoting the favorable supply functions of these centres as well as their accessibility (centrality). [Note the corollary for 'PARASITES'].

From this analysis, there was the attempt to derive the possible trip generation centres (source locations) for the sub-model 1. To do this, all centres were located on an X-Y plane in terms of the factor classifications above. These locations were found by plotting in Figure 5.2, the attraction factor on the Y-scale and the centrality-circulation factor on the X-scale. To each of the four columns on this plane, we identified the 'GENERATOR' and 'PARASITE' sectors; therefore there was an identification of locations in the various categories of the classification. Of the total of 26 locations in the GENERATORS column, 10 were in the 'Good' sub-column (upper right-hand column) suggesting that under the assumptions of the classification and observations, these could serve as possible

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*A slight modification was that in the attempt to have an equal number of rank classes for the attraction factor and centrality-circulation factor, there was a grouping of ranks for the centrality-circulation factor as was shown in column 4, Appendix VIII.

CLASSIFICATION OF CENTRES

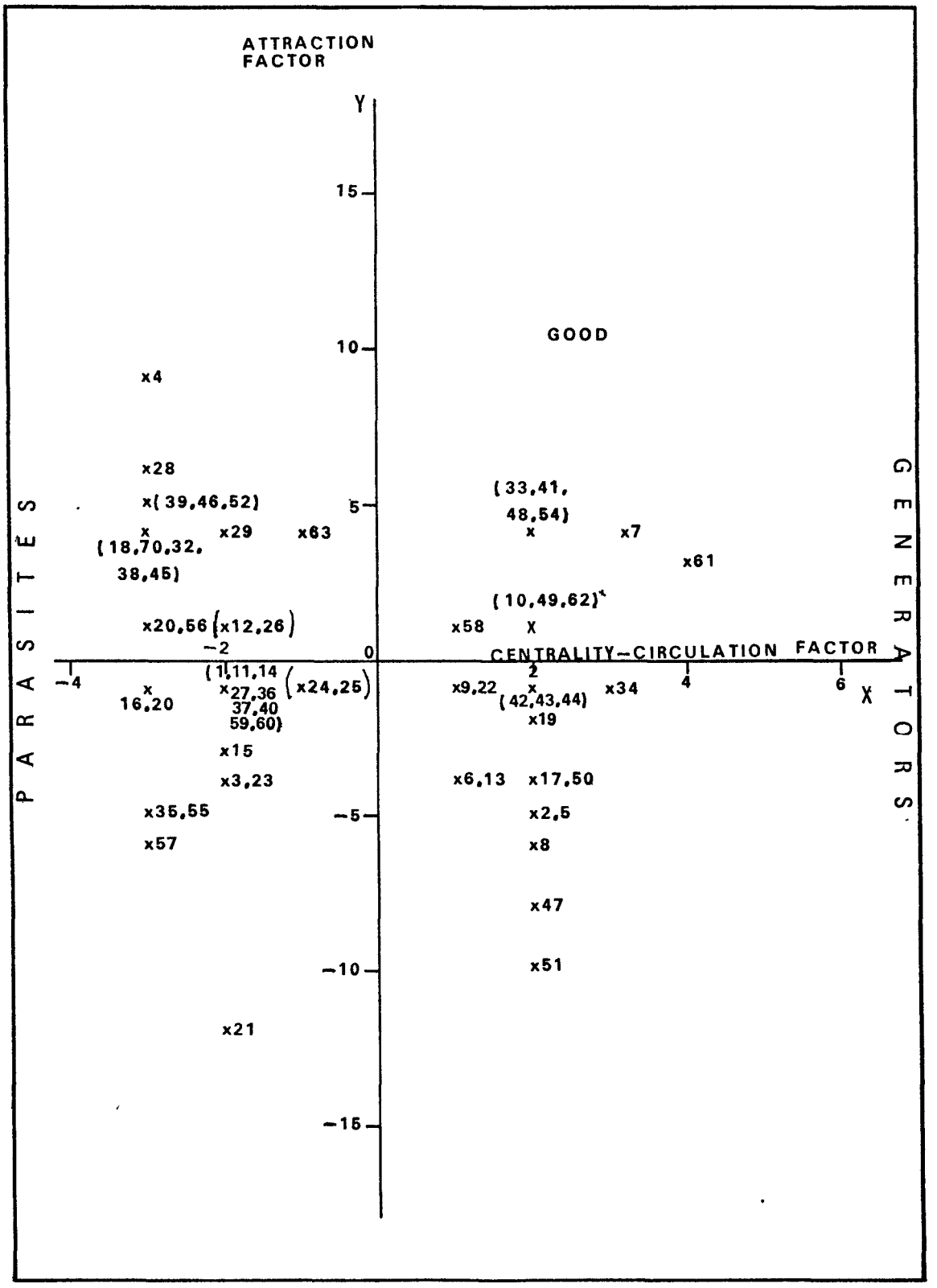

Fig. 5.2. : Distribution of study centres by factor scores.

TABLE 5.1

Characteristics of the Source Locations for

Salesmen's Tours

Source Name*	Location I.D.	Market Cycle	Total Population	Rank on AF**	Rank on CCF***	
LAGO	7	6 (F)	1,555	13	12	(1)
MURB	10	1	1,576	12	11	
JUAP	33	4	4,204	12	11	
MEDI	41	1	10,494	12	12	
IZOO	48	3	3,882	12	12	
JAKA	49	2	4,685	12	11	
NORF	54	3	2,175	12	12	
NYAN	58	1	2,194	11	11	
NUDE	61	1	6,526	14	11	
IFLA	62	2	13,815	12	11	

*Name used represent the computer index

**Attraction factor

***Centrality-circulation factor

(1) This location was rejected because it has a fixed market-day system, as indicated in column 3.

trip generation centres for the analysis of market centre networks in south-east Ghana.* From these centres, shown in Table 5.1 with their other characteristics, would be a distribution of trips within the constraints defined in Section 5.2. above.

Trip distribution

The basic steps adopted for this sub-model were a variation of the constrained location-allocation package (LAP) designed by Goodchild (1973, 85-139). The proximal solution sought for this sub-model was a derivation of the fewest number of circuits given the specified constraints above. The solution was to be derived by identifying the relationships between the various source locations identified in the sub-model on trip generation, and all other centres in the study region by making use of rank indices on the factors identified.

The basic problem in algebraic notation was

$$\text{Min} \sum_{i=j}^{n} \sum_{j=1}^{m} I_{ij} C_{ij}$$

$$\text{subject to} \quad \sum_{j=1}^{m} I_{ij} = S_i \quad \text{and} \quad \sum_{i=1}^{n} I_{ij} = D_j$$

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*It should be obvious to the reader that a rotation of these factors on the X- and Y-axis would provide an equal number of centres within each class, although there would be a 'change' in the location at the particular points.

where I_{ij} was the unknown relationship (i.e., allocation relationship) between each source location, i, and the Other demand points, j, located around it;

C_{ij} was the assigned attraction index for each centre;

S_i was the assigned centrality-circulation factor index at the source location, i,

D_i was the assigned centrality-circulation factor index at the demand point, j, (i.e., all other centres in the system).

In the simplest case, the relationships (bondages) we sought could be equated with the attraction between places and the demand and supply functions between these same places. As a linear function, the problem was expressed as

$$C_{ij} = \sqrt{(x_i - u_j)^2 + (Y_i - v_j)^2}$$

where x_i, Y_i were unknown relations between source and other centre;

and u_j, v_j were known demand/supply functions of locations.*

Stated otherwise, the proximal solution sought was that given the distribution of centres as defined in Figure 5.2 (the source locations and their attraction factor and centrality-circulation factor indices), we wish to find the 'best' relationships between each source location and the other centres in the system such that

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*The notations used in this analysis were the same as those originally used by Goodchild. The reason was to maintain some relation between this data and the original program; this does not mean however that cost was the desired output of this program.

in sub-model 3 (see below) when we assigned travel time and distance, total distance would be at the minimum for each set of locations in a circuit. At this point, it would be obvious that the relations may not be the minimum in terms of spatial interaction, since no space minimization constraint was introduced.

As a constrained case, each relational step consisted of a solution of the transportation problem. Allocations were therefore made from each of the 10 source locations to the various demand points in relation. Following upon the program instructions in Goodchild, all data were inputed in the steps defined (Goodchild, 1973, 90-96).

The 'title card' defined the name for each centre identified as a source location. Thus, for centre 7, the title card was designated as CIRCUIT 7. 'Data base' card defined all the centres in the study region. Each was shown as a digraph link to the other. The weight applied was the combined rank index in Appendix IX, column Z. The 'indifference' card was read in since a maximum-utility solution was sought; rank values for the attraction factor were read in and a definition of the class intervals noted. 'Iterations' were set at '0' since a transportation problem was to be solved. For the 'centres' card, the 'service constraint' was defined by the centrality-circulation rank for the source locations; the X, Y coordinates designated the source location (X) to each first related centre (Y). Since each centre was fixed, and no re-allocation of centres expected, centres were denoted to remain fixed (i.e., assigned 1). The 'go' card started the operation; and the 'stop" card indicated the end of operations.

In view of the fact that only 26 (i.e., 36%) centres had positive values on the rank index, and only 10 (i.e., 14.3%) had positive values on both the attraction and centrality-circulation ranks (see Fig. 5.2), each source centre was loaded with a large number of 'parasitic' centres. From the array of 'rank relations' shown for each source centre, the attempt was made in the next sub-model to assign time and distance functions to the related centres with a view to finding the circuits which could be completed within the limits of the given constraints.

Assignment

Simply stated, the assignment sub-model was designed to determine the circuits with the minimum total travel time and total travel distance, given all restraints as above. In mathematical notation, the problem was expressed as

$$\text{Min } D = \sum_{i=1}^{n} \sum_{j=1}^{n} a_{ij}\, x_{ij} ,$$

and

$$\text{Min } T = \sum_{i=1}^{n} \sum_{j=1}^{n} a_{ij}\, x_{ij} ,$$

both subject to

$$\sum_{i=1}^{n} x_{ij} = 1, \quad j = 1, 2, \ldots, n$$

and

$$\sum_{j=1}^{n} x_{ij} = 1, \quad i = 1, 2, \ldots, 29$$

and

$$x_{ij} = 0, -1, \ldots, -14 \text{ , or, } 0, 1, \ldots, 9.$$

where a_{ij} was an element of relationship derived from LAP;

D was total completion distance of all tours in a circuit;

T was total completion time of all tours in a circuit;

21-23 for x_{ij} was notation for 'parasitic' centre in LAP

11-14 for x_{ij} was notation for 'generator' centre in LAP

Although this problem could be solved as a general linear programming model, the basic steps described below were taken manually.

First, there was a generation of movements from each source location through the rows of links derived in descending rank order from LAP. Each link was transferred on to a graph of the type in Figure 5.1, and the distance and time values assigned from Appendix 1. This transfer of row column links from LAP to a graph link was necessary since LAP steps were linearly ranked and did not close. In making a transfer of row links, to the graph links, it was necessary to remember that for every 8th step, there ought to be a generator centre intervening, in a salesman's schedule of tours. It was also observed that the rank orders from LAP only served as guides in the visitation schedule of salesmen, since a salesman could visit a given centre for any reasonable number of times.

Second, for the sets of links for which rank values in LAP were similar, split assignment problems were solved. This involved finding the shortest travel time and distance relation to the nearest centre.

Third, repeat the selection of centres until the 29th step ended on the source location. For circuits which would not end on the 29th step at the source locations, reject as an insoluble problem.

Finally, find total travel time and travel distance for all closed circuits and find those which satisfied the constraints on total time and distance.

Mainly because circuit 7 has a fixed day for a starting day of a salesman's tour, it was rejected in the analysis of data. Thus, there were in all 9 circuits for which to arrange salesmen's tours. The total distance and total travel time for each circuit, as well as the centres visited within each circuit were tabulated into Appendices X through XII. The characteristics of these data and their relevance for the purposes of this thesis are presented in the next section.

5.4 Data Output and Analysis

Data Output

The problem of finding the fewest number of circuits from which there could be some interpretation of the nature of relationships between market centres in south-east Ghana was attempted by dividing the model of analysis into 3 sub-models. The trip-generation sub-model aided the identification of possible source locations for the determination of circuits. The trip distribution model aided in showing the relationships between the various source locations and the array of trading centres in the study region. Although in terms of these relationships, five possible circuits were defined by the program*, the spatial relations expected between the source locations

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*Five 'circuits' were said to be defined by this program because the rank-order relations generated for the following linear functions were identical: source location #s 33, 41, 48 and 54; and source location #s 10, 49 and 62. In addition to these two groups, the following source locations each had its distinctive rank ordering of locations: centre #7, #58, and #61.

and the related centres were not in any way indicated. What was achieved from this sub-model was the relationship between centres in terms of the demand and supply needs of locations in the study region, and how related these were to the attractiveness of each source location. To a large extent, these relations were critical in scheduling salesmen's tours in the assignment sub-model.

A summary of the characteristics of the various circuits derived from the manual scheduling of salesmen's tours was tabulated into Table 5.2. The constraints applied in the selection of the fewest number of possible circuits were discussed as follows.

Of the nine tours scheduled as in the chromatic travelling salesmen problem, all salesmen returned to their respective starting locations and on the 29th step, except the tour generated from centre #41. The salesman returned to base a day earlier; the circuit defined by this salesman was therefore rejected, since a constraint was not observed. This reduced the number of completed circuits to choose from to eight.

A spatial distribution of these source locations, and the circuits defined showed that only two circuits were not in the south-eastern section of the study region. Only centre #10 was found in northern sector of the study region, and circuit #33 in the western sector. An interpretation of this observation could be that there is a dense marketing activity in the southern and south-eastern portion of the region; this interpretation could be given support by Figure 3.2 on the walking distance of the population to market places. As was indicated for this figure, up to about 200

TABLE 5.2

Summary Characteristics of Defined Circuits

Circuit Number	Total Travel Distance (in kms)	Total Travel Time (in mins)	Mean Travel Distance (in kms)	Mean Travel Time (in mins)	Percentage of Areas Served in circuit	Percentage of Areas Served in region	Comments
10	749	1395	26.8	49.6	85 ($\frac{21}{25}$ x 100)	30 ($\frac{21}{70}$ x 100)	
33	943	1553	33.7	55.5	85.7 ($\frac{24}{28}$ x 100)	34.3 ($\frac{24}{70}$ x 100)	
41	787	1250	29.2	46.3	84.4 ($\frac{27}{32}$ x 100)	38.6 ($\frac{27}{70}$ x 100)	Step 4 (centre #57 same as for circuit 58. Steps 9-11 same as for circuit 58.
48	853	1129	30.5	40.3	85.4 ($\frac{18}{21}$ x 100)	25.7 ($\frac{18}{70}$ x 100)	Step 18 (centre #57) same as for circuit 54
49	849	1170	30.3	41.8	85.7 ($\frac{18}{21}$ x 100)	25.7 ($\frac{18}{70}$ x 100)	Steps 11 (centre #57), 23 (same cemtre) and 28 (centre #51) same as for circuit 62

48	853	1129	30.5	40.3	85.4 ($\frac{18}{21}$ x 100)	25.7 ($\frac{18}{70}$ x 100)	Step 18 (centre #57) same as for circuit 54
49	849	1170	30.3	41.8	85.7 ($\frac{18}{21}$ x 100)	25.7 ($\frac{18}{70}$ x 100)	Steps 11 (centre #57), 23 (same cemtre) and 28 (centre #51) same as for circuit 62
54	830	1205	29.6	43.0	71.4 ($\frac{15}{21}$ x 100)	21.4 ($\frac{15}{70}$ x 100)	Same comments for circuit 48
58	1134	1550	40.5	55.4	71.4	21.4	Steps 9-11 same as for circuit 41; Step 9 same as for circuit 61. Exceeded total travel distance.
61	782	1155	27.9	41.3	81 ($\frac{18}{21}$ x 100)	24.3 ($\frac{18}{70}$ x 100)	See circuit 58
62	869	1195	31.0	42.7	81 ($\frac{17}{21}$ x 100)	24.3 ($\frac{17}{70}$ x 100)	See circuit 49.

people could walk up to 15 kilometres each way daily in order to attend a periodic market.

Of the six circuits identified in this south-eastern portion of the study region, circuit 58 was observed to exceed the constraints on total travel distance. Total travel distance expected was 980 kms; but this circuit's total was 1134 kms. Thus the circuit was rejected as inefficient under the defined constraints. The problem of finding the fewest number of circuits at this point involved making a choice between the five remaining circuits in the south-east section of the region, since most of the circuits were duplicates of each other. Constraints used to eliminate the 'efficient' circuits were the time and distance travel functions, and the specification that in the assignment of tours no two salesmen should be found at the same centre, except on a non-marketing day. Violations of this constraint were observed, for most circuits, and tabulated into the 'comment' column in Table 5.2. In such cases of coincidence of salesmen's schedules, a recourse was made to the totals and means of travel distance and time for the selection of a more efficient circuit, since it was observed that almost all of the circuits had similar distribution in spatial terms. Thus, for example, where circuits 48 and 54 had their 18th step meeting at centre #57, (see Appendix XII, columns 1, 2 and 5), a recourse was made to the circuit with a better performance on total and mean of travel distance. Circuit 54 was thus chosen as a 'better' representative circuit. With this elimination process, circuits 49, 54 and 61 remained as the suitable representative circuits in the south-eastern portion of the study region.

Since all circuits so far derived have satisfied all constraints specified for each sub-model, a recourse was made to an additional constraint for the derivation of a representative circuit from among circuits 49, 54 and 61. The constraint was that the expected representative circuit must exhibit the highest coverage indices for places within that section of the study region. From an inspection of the "percent of centres visited" column in Table 5.2, a choice for circuit 49 was made; this circuit showed the highest link for all places within the section to be served (i.e. 85.7%) and for all places in the whole region (i.e., 25.7%). Thus, within the limits of the constraints set for the various sub-models derived from a preliminary analytical stage of the planning model in Figure 4.3, it has been derived that the three circuits based on centres 10, 33 and 49 provided the maximum linkage of the system of places in south-east Ghana. These circuits thus represent the fewest number of salesmen's tours that could be expected to link the highest number of places in south-east Ghana. To statistically check if the linkage of places provided by these circuits were within limits of expectation, a Kolmogorov–Smirnov test was performed for the distribution of visits by salesmen to each node.

A tabulation of the frequency distribution of salesmen's tours was built into Appendix XIII. A summary of this distribution, built into Table 5.3 showed that for the study region as a whole, the expected visit per centre was 1.24; the calculated frequency of visit per centre for the circuits was shown in the last row of this table. For the frequency of visitation to each centre, it

TABLE 5.3

Distribution of Visits to Centres in Salesmen's Circuits

Frequency Distribution	South-East Ghana		Circuit 10		Circuit 33		Circuit 49	
	Number of centres	Number of visits	Number of centres	Number of visits	Number of centres	Number of visits	Number of centres	Number of visits
0	11	0	4	0	4	0	2	0
1	41	41	15	15	20	20	10	10
2	10	20	4	8	1	2	5	10
3	6	18	2	6	1	3	3	9
4	2	8	0	0	1	4	0	0
Total	70	87	25	29	27	29	20	29
Mean (visit/centre)	1.24		1.16		1.07		1.45	

was observed that one link visitation was the mode for all circuits and the region(i.e. 41 for the region; 15 for circuit 10, 20 for circuit 33 and 10 for circuit 49.). A sketch of these distributions for the centres and the frequency of visits was shown in Figure 5.3. It interpretes that for the centres in the study region, the mean of distribution for the circuits corresponded proportionately to the expected distribution over the region (Fig. 5.3 a). The frequency of visits' sketch, shown in Fig. 5.3 b indicates a similarity in trend of proportionate dispersion for all circuits relative to the mean for the study region.

However, it should be noted that there are some differences in the overall distribution of the number of centres visited and the corresponding frequency of visits to these centres. To test for the significance of these differences the Kolmogorov-Smirnov non-parametric two-sample test was applied(Gregory, 1978, 130-136; Taylor, 1977, 124-125). The aim of this test was to compare data derived for south-east Ghana to data for each of the circuits, and by that test the null-hypothesis(H_0) that no significant differences exist between the data for south-east Ghana and those for the circuits if the tabled values (Index) for the analysis exceed those for the circuits. The probability level of .05 was assumed and thus the formula

$$1.36 \frac{N_1 + N_2}{N_1 \times N_2}$$

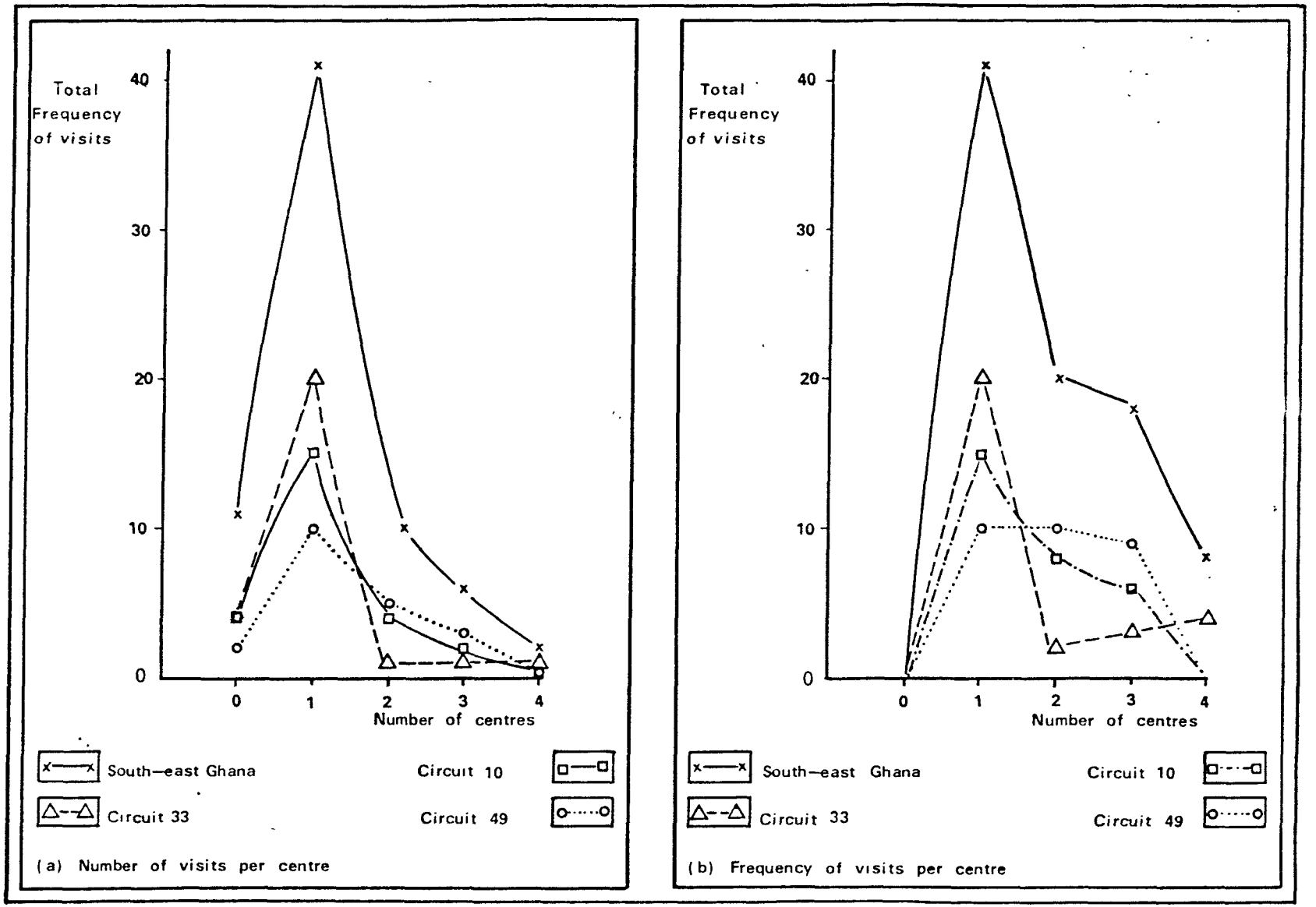


Fig. 5.3 : Sketch illustration of frequency of visits to centres.

was applied(Gregory, ibid, 136; Taylor, ibid, 343).

where, N_1 was the number of centres in south-east Ghana; and

N_2 was the number of centres in each circuit.

As shown in Table 5.4 d, no value for any of the circuits exceeded the index from the statistic, and therefore the null-hypothesis was confirmed in all cases. By this analysis of the frequency distribution to the various centres in south-east Ghana, it has been established statistically that number of visits to each node, and frequency of visit to nodes within each circuit was approximate to the expected. Given the assumption in Section 5.1, it could be said that since by these distributions, the largest number of centres were linked in the study region, the inference could also be made that the three circuits described the proximal solution of the fewest number of circuits expected over the study region.

Data Analysis

A general pattern described by the derived circuits, as shown in Figure 5.4, was entity maintained by each circuit. Each circuit seemed to be self-contained, with a common convergence point at centre #28. Given the entity of these circuits, it could be said that each described a geographical space which could be described

TABLE 5.4
KOLMOGOROV-SMIRNOV STATISTICAL TEST FOR DATA ON MARKET PLACE FREQUENCY VISITATION.

ACCUMULATION

	NUMBER OF CENTRES VISITED						FREQUENCY OF VISITS					
	0	1	2	3	4	D	0	1	2	3	4	D
SOUTH-EAST GHANA	11	52	62	68	70	-	0	41	61	79	87	-
CIRCUIT 10	4	19	23	25	25	-	0	15	23	29	29	-
CIRCUIT 33	4	24	25	26	27	-	0	20	2	25	29	-
CIRCUIT 49	2	12	17	20	20	-	0	10	29	29	29	-

PROPORTION

SOUTH-EAST GHANA	.16	.74	.89	.97	1	-	0	.47	.70	.91	1	
CIRCUIT 10	.16	.76	.92	.1	1	-	0	.52	.79	1.0	1	-
CIRCUIT 33	.15	.89	.93	.96	1	-	0	.69	.76	.86	1	-
CIRCUIT 49	.10	.60	.85	1	1	-	0	.35	.69	1.0	1	-

DIFFERENCE

SOUTH-EAST GHANA	-	-	-	-	-	-	-	-	-	-	-	-
CIRCUIT 10	.03	.02	.04	.03	0	.03	0	.05	.09	.09	0	.09
CIRCUIT 33	.01	.15	.04	.01	0	.15	0	.03	.06	.05	0	.06
CIRCUIT 49	.06	.14	.04	.03	0	.14	0	.13	.01	.09	0	.13

SIGNIFICANCE

	NUMBER OF CENTRES VISITED			FREQUENCY OF VISITS		
	D	INDEX	COMMENT	D	INDEX	COMMENT
CIRCUIT 10	.03	.32	NS*	.09	.29	NS *
CIRCUIT 33	.15	.31	NS	.06	.29	NS
CIRCUIT 49	.14	.35	NS	.13	.29	NS

INDEX = VALUE FROM FORMULA QUOTED IN TEXT ABOVE.
NS * = NOT SIGNIFICANT
D = DIFFERENCE IN QUOTED INDICES BETWEEN SOUTH-EAST GHANA AND THE DERIVED CIRCUITS.

END

!

as northern (circuit 10), western (circuit 33) and eastern (circuit 49). For the northern circuit, only centres #1 and #19 which were wholly located within the political unit of Ghana were not visited. For centre #19, it should be noted that unless a journey was initiated from there, there was no way a salesman's tour could be scheduled to that centre, given the constraints of the analysis. No general pattern of movement could be attributed to this circuit since the distribution of centres in terms of the relations between supply and demand functions was not regular. However, it could be said that short step-wise movements were common in the salesman's schedules of visits. The three longest steps taken were between centres 5 and 3 (steps 3 and 4), centres 8 and 28 (steps 16 and 17), and centres 66 and 68 (steps 22 and 23). Apart from these long steps, most other steps were within the coverage described for the region (i.e., 35 kms) and the circuit (26.8 kms).

Using the frequency of visitation to a centre as indicating that centre's importance as a marketing centre, it could be said that two important market locations could be found within this circuit. Centre #10 and centre #8 were these locations, with three visitations per centre. Of the 29 centres enclosed within this circuit, only eleven (or 38%) were identified as attracting a more than average of their population on market days. Of these eleven centres only 2 (or 6.9% of all centres) could be described as attractive, as well as centrality located to generate some surplus into the system of places in south-east Ghana. Centres in the circuit could therefore be assumed to be places in need of produce

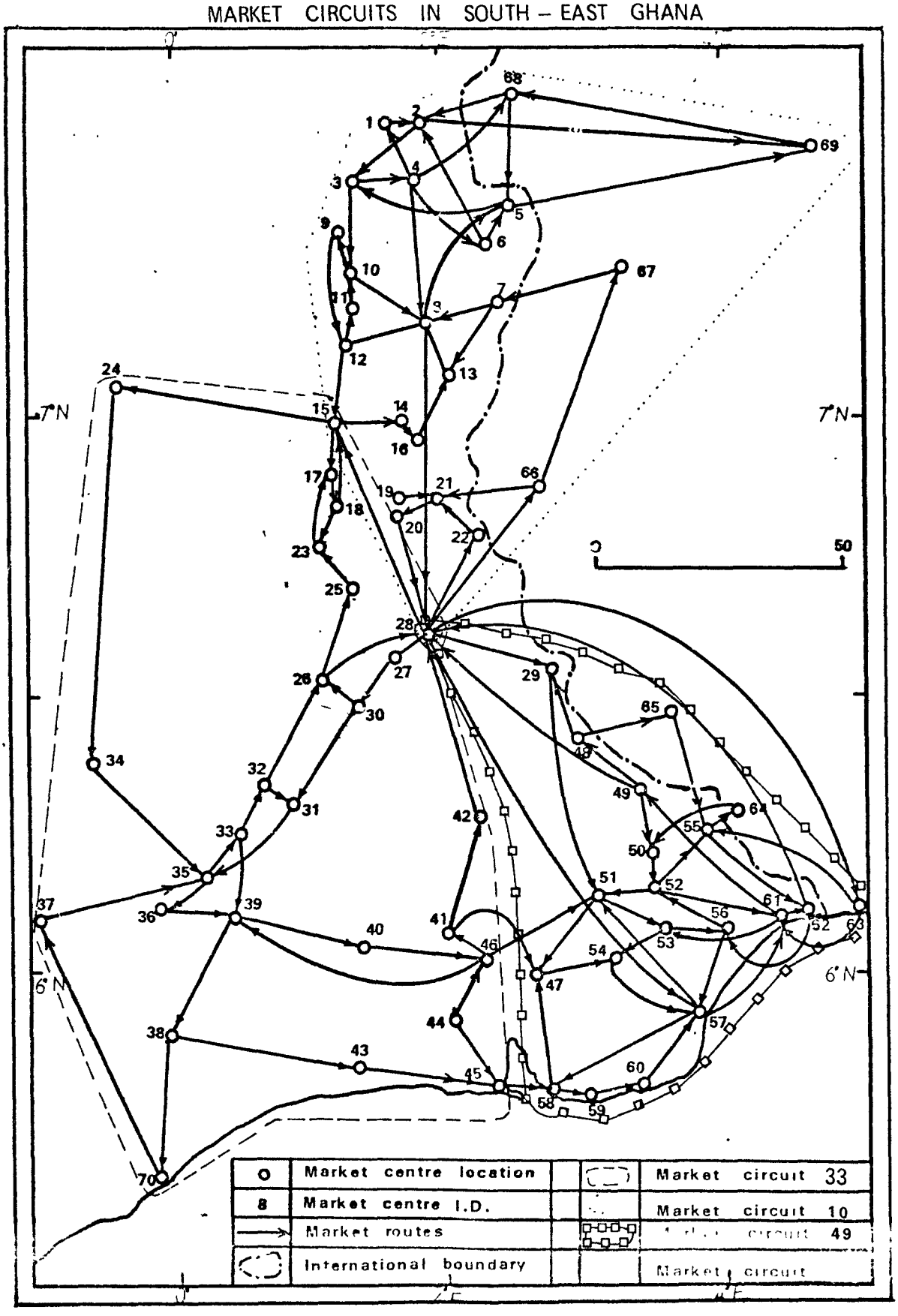


Fig. 5.4 : Structure of derived circuits in south –east Ghana.

or services to buy.

Apart from centre 28 which linked all circuits together, centre 15 might also be described as a bridghead between circuits 10 and 33. The intricate network of centres described by the pattern and intensity of links in circuit 10 seemed to be absent in circuit 33. Because settlements were generally, irregularly located, visitation links were likewise irregular. Of the total of 27 centres enclosed within the circuit, 4 were not visited at all. Of those visited, 1 was visited 4 times (the originating centre), and one other was visited three times. That apart, all other centres were visited once, except centre 35. (For centre 15, the other visit was by the salesman from circuit 10). That there was an unfavorable environment for periodic market trade in this circuit was evidenced by the fact that only 6 (or 22%) of all centres in the circuit attracted a more than average proportion of their populations on marketing days; of this number, only 2 centres (or 7.4%) were 'GENERATORS'.

The most intensive marketing interaction was provided by circuit 49. Proofs for this observation could be inferred from the visitation per centre index of 1.45 which was the only one higher than the mean for the region. The interpretation for this in terms of the individual centres was that of the 20 centres enclosed by this circuit, only two were not linked by the salesman's circuit (i.e., centres 63 and 65); and of those linked, 8 (40%) had two or more visits per centre. Furthermore, it was evident that of the 11 source locations identified in the trip generation

sub-model, seven (63%) were located in this circuit alone. This might be a factor in explaining the intense interaction between the centres in this circuit with each other, and with the other centres in the study region in the trip distribution sub-model. Within this circuit, three important market locations could be identified showing visitation of 3 per each such centre (centres 52, 57, and 61). Like circuit 10, length of each trip as well as travel time trip was around the average of 30.3 for the circuit. Given that the walking range for people in centre 51 showed a value of 15 kms maximum could be interpreted as a factor in the high link per node identification within the circuit.

Implications of results

The general pattern of link for the region through periodic market visitations was one of adjoining circuits, each with a defined pattern. For circuit 33, the pattern of visitation was one of a simple linearly identified system; for circuit 49, the pattern was one of a complex system, with links in an almost circular order. For circuit 10, there was the integration of these two patterns (see Fig. 5.5). These patterns could be equated to the patterns described by Adalemo (1975) and sketched into Figure 4.2. A variation of the pattern in south-east Ghana however indicated a convergence of the three identifiable circuits on a common market location (i.e., centre #28). Within each circuit, the important market locations were found to be in close proximity to each other. The characteristics of these important market locations were tabulated into Table 5.4. These important locations, which

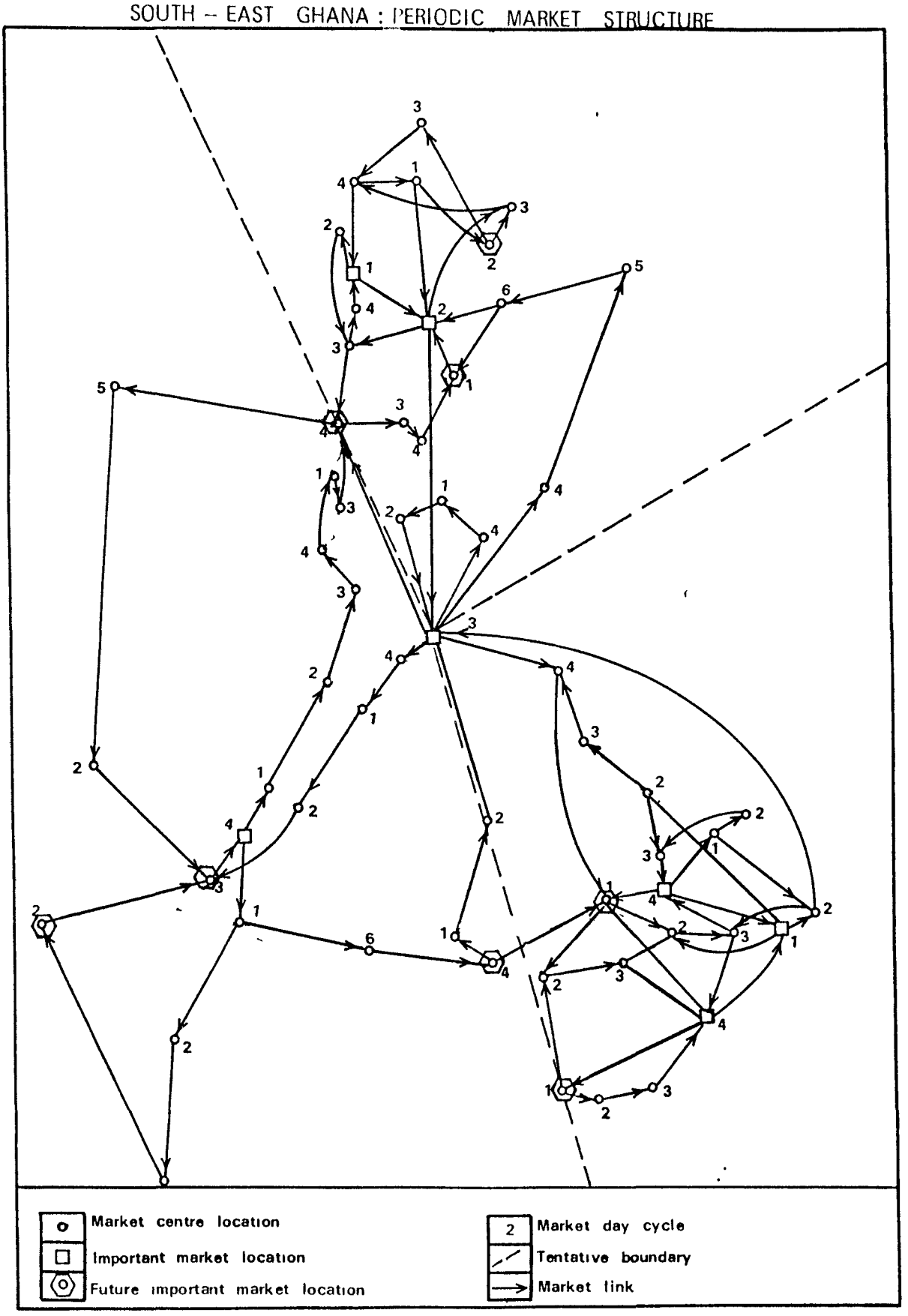


Fig. 5.5 : Market sequence movements and circuit types in south–east Ghana.

represent the markets places visited most frequently by marketers were seven in number. Of this number, four are administrative centres within the region. Centre 28, (Ho), is the administrative capital of the region. Centres 8 (Hohoe), 57, (Keta), and 61 (Denu) are district administrative centres in the region. This could be interpreted to mean that the circulation paths of periodic market traders eventually converge on local administrative centres, indicating that there is some link, even where remote, between market place sub-systems and urban-place subsystems in the study region. But the relationship does not suggest any of the pattern in terms defined by central place hierarchical systems. Rather the emerging pattern is a relationship between local producing centres (source locations) in an unidentified relationship with their urban systems. It is in terms of the unidentified relationship that the paradigm of the autonomous development system could be of relevance to planners. For example, in designing for a relationship what characteristic policies would have to be pursued? Should the policies necessarily be from an external agent?

In terms of the autonomous development paradigm, any set of policies would have to depend upon the proven and potential resources of a specified region. Given, for example, that the production domain of circuit 49 is for salt-making, ocean fishing, corn production and palm oil production (see Figure 3.4), there could be set goals to design sub-units of this circuit on the intensification and/or the diversification of these agricultural activities. The identifiable sub-units suggested by the network of market centres depend on centres 52, 57 and 61. Possible future

TABLE 5.5

Characteristics of Important Market locations

in South-east Ghana

Centre ID	Centre Name	Population	Number of Marketers	Net Vertex	Centrality	Composite Rank	Comment
8	Hohoe	19,810	1540	-1	7	1221	District capital
10	Burbula	1,576	200	0	4	1211	
28	Ho	43,590	2010	1	13	2312	Regional capital
33	Juapong	4,204	300	1	3	1211	
52	Ohawu	1,659	100	1	5	2312	Agricultural station
57	Keta	29,746	1800	-1	7	2321	District capital
61	Denu	6,526	1500	0	6	1411	District capital

market locations for the integration of circuits and specialization of production could then be centres 47, 51 and 58, as shown in Figure 5.5. With similar strategically located and important market locations identified all over the region, it would be within limits to suggest that the role of periodic market systems, in the development planning of south-east Ghana could become significant if more intensive research be carried on to understand the system better.

5.4 Summary

In this chapter, an attempt was made to classify data with a view to deriving relationships between marketing centres in south-east Ghana. The outcome was the derivation of three main circuits which provide some required relationships.

In order to achieve the above aim, the relationship between graph theory analytical frame and periodic market structure was suggested in Section 5.1. Given the basis of this relationship as the determination of cutpoints or bridgeheads which bind places, and therefore, people together, the objectives of the use of data as well as the required propositions for such analysis were stated (i.e., Section 5.2). From the objectives and the related propositions, the analytical part of the model of the thesis was divided to coincide with the objectives and propositions in Section 5.2. Thus, a trip generation, a trip distribution, and (trip) assignment sub-models were laid out. The method of analysis of data for each of these sub-models was then explained in a logical sequence in Section 5.3. From these sub-models it was possible to obtain some possible generation centres from which trips could be started in

order to find a consistent relationship between places in the study region. From the classification of available data in terms of the above sub-models, a possible 5 circuit classification of the region was derived. But it was known at this stage that for the south-eastern part of the region under study, there was a replication of centre visitation by salesmen's assigned to the circuits. As a further constraint, it was suggested to introduce a coverage index in the choice of circuits. From this, a total of three circuits were established; a statistical proof that these circuits provided a maximum possible linkage between places in the study region, and therefore that the derived circuits were the proximal, was made.

The analysis of the structure and movement patterns within these circuits was made in the second part of Section 5.3. It was noted that the convergence of the three circuits provided a dimension in the relationship between circuits which was not noted in the analysis by Adalemo (1975). The general patterns of simple and complex movements within circuits was observed for the study region too, confirming the earlier findings by Adalemo (1975), Brown and Harvey (1977), and Alao (1972) among others. In terms of the use of data in deriving these patterns, what was shown was a movement away from the concept of the market week in defining market rings, to one of the market month in defining the same phenomenon. This could imply that the basic characteristics of the nature and patterns of market place visitation was specific, irrespective of the time dimension in defining the system. It was also to be noted

that no matter the length of the time dimension, visitation paths were limited to a cognizance of the extent of an environment (circuit) by marketers (i.e., in describing a market month, circulation and therefore interaction between places was only intensified and not extended in space).

In consideration of the derived circuits for the organization of space for development planning, it was suggested that from the interaction between trip generation points (source locations)--which are all rural areas with population less than 5,000 as Table 5.1 showed--and other marketing centres, there could be described for the study region urban-place and market-place sub-models. But these were linked in a relationship not discernible from the analysis. If therefore, further studies were conducted and the nature of the relationships could be established, then there might be the possibilities of designing some development programs from such interactions. But from the relationships between places in the study region, and the environment of autonomous development planning, it was suggested, in terms of circuit 49, that the bridgeheads locations suggested by centres 52, 57 and 61 provided intuitions for the subdivision of the circuit for the intensification and/or diversification of space for development. From this, other possible locations which could be so designed were suggested for the circuit. The expectation was that by an articulation of these ideas, there could be generated some design patterns in the relations between places organized around periodic market circulation paths. The fashioning of such designs into goals around which policies could be organized

would provide an environment for the organization of space in terms of the autonomous development paradigm.

It is worth remarking that the successes of achievement reported in the analysis of data have not been without errors; the attention in the next chapter would therefore be focused on these errors and their sources as they relate to the arguments upon which this thesis was established.

CHAPTER VI

SUMMARY, EVALUATION AND CONCLUSION

In this concluding chapter to a study of the spatial relations of periodic market systems in south-east Ghana for development planning in that region, the attempt would be made to summarize and evaluate what have been achieved, so that some conclusion could be drawn for possible future studies of this nature. To attain this purpose, the chapter was divided into three main sections. In Section 6.1, concerned with a summary of the study, there was--recapitulation on the outlines of the problems, the hypothesis tested, and the arguments and methodology adopted for an understanding of the purposes of the thesis. As would be recalled, in outlining the methodology of the study, various propositions were made with a view to showing some consistency between the arguments of the essay, and the data available for the study. The implications of these assumptions for the attainment of the purposes of the study were evaluated in Section 6.2; the evaluation of these propositions was made in terms of the environment of the study region, the planning paradigm of the Third World, the structure and mechanisms of periodic market systems, the data analysed and the results obtained. In Section 6.3, a brief conclusion was drawn of the whole study.

6.3 Summary

In an attempt to focus a study on how periodic markets could be meaningfully understood for development planning in the Third World

in terms of their spatial characteristics three broad problems were posed. First, the argument was introduced that in view of their indigenous character, and in view of the fact that such characteristics provided no sound pedestal for the 'take-off' to development generation in the Western world, periodic market studies in the Third World, with the sole purpose of deriving some planning goals was unwarranted. The second argument introduced was that since in the history of the existence of these durable and flexible periodic markets, they have not exhibited any ability to generate any organized and highly monetized payment and distribution system, their study was bound to meet with opposition from most planning sources. A final argument introduced was that on account of their 'informal' structure, there may not exist any standard and/or coherent methodological systems relevant to the study of these periodic markets. In order to find some basis for argument in terms of these problems , some connectivity indices from the environment of the study region were provided. For example, it was shown through a comparison of the periodic market network system of places, and the motor-road and waterway networks of these same places in south-east Ghana that the network system of the former (with an emphasis on the indigenous method of walking to market places) was superior to those of the modern transport system of the region (i.e., Section 3.1). It was also shown in Section 4.2 that since the periodic incidence of these episodic markets contributed to a definition of exclusive sets of market places which bind specific locations and their people together into market circuits, there were grounds for arguing that these periodic market systems possess some organized

internal trade system which if structured on some coherent planning paradigm could help in the generation of development for the rural areas which they serve. The thesis propounded at the end of these illustrations was that if the focus of the Third World's development paradigm was autonomous development, by which was meant an internalization upon the known resources of a place with the view not only to using these resources for the transformation of people and place, but also for the transformation of the ideologies and values upon which these resources were structured, it was suggested that periodic markets provided the vehicle through which the planning problems of most Third World areas could be solved. In the test of this thesis in south-east Ghana through a simple planning model, it was shown that by the use of some operations research sub-models, it was possible to structure space in the region into three functionally related regions (market circuits) through which goods and services were known to be circulated. From these related regions, it was also indicated how space could be designed for the initiation and implementation of development planning.

A conclusion that was drawn at the end of this study was a confirmation of the hypothesis of the thesis that with some knowledge of the details of actual conditions and behavioral characteristics of marketers in south-east Ghana, and given the planning goals and philosophy of that region, some logically structured constructs could be found for the design of a coherent development planning program, especially in the rural areas in which these periodic market systems are a way of life for the mass of the people.

It is relevant to note that in designing the theme and methodology of this thesis for the derivation of the above conclusion, various assumptions were made and logical steps taken in conformity with the purposes of the study. In the next section, consideration is given to the effects of these assumptions and steps on the conclusions of the thesis.

6.2 Evaluation

A basic step initiated to show that in spite of their indigenous character periodic market systems provide a better connection of places was to devise a comparison of their networks to those of motor-roads and waterways. What was stressed was that the complement of walking distances to the modern transport system was the basis of the superiority of these market networks to motor-roads and waterways alone. What was not shown however was the volume of goods transported through these systems; this was not shown because the argument was that these periodic market systems have not shown any organized distribution system in their long history of existence.

If, however, the argument is to be switched to the volume of goods and services transported through these media of network (i.e, walking and vehicular transport combined, and vehicular transport alone) then different sets of data may be needed altogether in an analysis of the roles of periodic market systems in development planning. However, even if the arguments on the volume of goods and services were to be advanced, it must be borne in mind that any standardized volume suggested must be in an equitable demand and supply relationship to the locations served in the space region.

Stated otherwise, the production function must be consistent with the philosophical background of the development planning space.

In presenting the argument and illustration that periodic market systems in south-east Ghana have an organized distribution system which could be usefully adapted for the design of development planning in that region, various assumptions were adopted for the collection and analysis of data. For example, a condition set for the choice of centres analysed in the study was that these centres must have populations greater than 1,000 people, and on a market day, be attractive to 100 or more people. These limitations precluded the study of smaller centres; centres for which periodic marketing is a way of life. An effect of such limitation was that centre #19 was shown to have no contact with any other source centre. This, technically disqualifies an analysis of the region in graph-theoretic terms, since graph theory locations must be finitely related (Tinkler, 1975). In real life experience, centre #19 is connected to a centre which has population less than the required minimum for this analysis. Such problems also limit the digraph notation set on most links. For example, there are links between centres 30, 31, 40, 41, and 42, through myriads of small centre periodic markets; but these could not be shown for this study.

Another problem encountered in the choice of centres and the movement of salesmen through them was the case of 'boundary' locations. Two boundary types were encountered in this study: there was the boundary set by international political adjudication (i.e., Republic of Togo) and the boundary set by a natural phenomenon (i.e., the

Volta River and Lake). For the international boundary problem, the location of centres was extended as far as the last major centres in the study region had contacts with them. What was not shown was the link of these boundary locations to other centres outward from the study region. What resulted was that there was a 'distortion' in the indices derived for these locations on the Attraction factor and Centrality-circulation factor scales. Thus, for example, centre #63, which is also the capital city of the Republic of Togo, was shown to have only one link converging on it (demand function) and two links diverging from it (supply function). As relevant as other links to these boundary locations might be, they were not shown, and this was done for reasons stated in Section 2.2. Similarly, locations westward of the Volta Lake were shown in their relationship to centres in the study region. Thus, for example, centre #37, which has been shown by Van Appeldoorn (1972) to have many contacts to centres around it was shown here as with only two contacts; this was because those contact points are external to the study region of this thesis. It is therefore to be expected that with more detailed information on other parts of the country, the integration points of circuit 33 with an adjacent circuit westward might be derived and the determination of other important market locations denoted.

Data analysed for the derivation of source locations for salesmen's tours and the definition of circuits were based on four observations: population at a centre and its attractive force on a market day; and, the centrality of a location as related to its ability to generate supply of goods and services on demand for goods and services

from other locations near it, given the sequence of market schedules in space. What this implied for the analysis was that these were the major determinants of marketers cognitive knowledge of their environment. As much as these data may be said to imply more than economic connotations for marketers' visitations, they also implied some inherent problems for the results obtained from their analysis. For example, whilst the mean of link per node derived from such analysis was 3.6, and was therefore the basis of determining the class intervals on the centrality-circulation factor (Section 5.3), it must be borne in mind that this index differed from the 1.7 link per node index shown in Table 3.2, and the 1.24 expected link per node index used for the Kolmogorov-Smirnov test in Table 5.4. An implication of this might be that, the basis of defining the observations for the analysis, if restructured might provide variations in expected results of another analysis. What might result if the significance of link node index were scheduled on a 1.7 index was a reclassification of centres on different sections of Figure 5.2, and therefore a large number of source locations for analysis. There might thus be a different set of circuits; but their coverage index might not be too different from what has been obtained; neither would the patterns of visitation and links be different, for the market sequence links were predetermined and not dependent on the link per node score. Furthermore, it must be observed too that marketers' knowledge of market schedules was fixed over time; thus the choice of other source locations may affect only the locations to be included in each circuit, and not the range of visitation.

Given this analysis, the suggestion could be made that for other studies of this nature, sample centres must be those whose populations are characteristically small, and showing some relationship in periodic marketing activities. This suggestion, as results obtained have shown, should not be interpreted decisively to mean that periodic marketing activities are entirely small centre activity. As has been illustrated, the important market locations were those with urban functions (Table 5.5). The critical balance of the extent of these marketing activities between small (periodic market place systems) and large centres (urban-place systems) is therefore one area worth investigating, if the organization of marketing activities as a vehicle for the generation of development in rural areas is to become prominent.

6.3 Conclusion

What classical theories on development have not failed to assert is that development is a function of large towns, a spatial restructuring of space in some systematic forms, and massive industrialization for the mass production and circulation of goods and services. With the impress of such theories, it is no wonder that the 'myth' of the small place, the village, and all of its mysterious and sometimes 'primitive' social, political, economic, spiritual and spatial values have never been called into question where suggestions for the development of space and people were made. The attempt in this study was to show that a characteristic structure of the small place in the Third World, (i.e., periodic market systems) is worth studying, not only for its economic, social or spatial

rationality, but also for the relevance of its systems for the organization of space for development planning. In view of the results obtained from an analysis of periodic market systems in south-east Ghana, given various operationable heuristics from graph theory and location-allocation problems, it could be said that the myth of the small place as a primitive environment which has to be discarded before any development took off might not be enduring for too long.

What became explicit at the end was that the problems of the thesis, given the environment of south-east Ghana could be reread thus: since periodic markets have been shown to exhibit some ability and potential for the organization of space in terms of the collection, payment and redistribution of goods, services and information; and since the focus of development was on an articulation of spatial functionalism (derived from levels of production and technology) which subsequently could be translated into a search for some indigenous characteristics of various places, periodic markets could be said to possess some meaningful framework for the development of some parts of the Third World. What was also shown to be of advantage in the use of periodic markets for development studies has been the availability of various operations research heuristics.

In terms of these arguments a visualization of a problem in terms of spatial differentiation was attempted. What was not attempted was the explanation of the problem as it related to the creation of appropriate institutions that could help to shape and to steadily stimulate a development process and make possible the attainment of

carefully estimated targets and goals. These are some of the problems which it is hoped some further researches might be based upon, as more information becomes available, especially at the micro level.

APPENDIX 1

TRAVEL DISTANCE (DISFUM) AND TIME (TRATIME) BETWEEN CENTRES IN STUDY REGION

FROM CENTRE	TO CENTRE	DISTANCE (IN KMS)	TIME (IN MINS.)
1	2	25	40
2	3	35	75
2	69	85	115
3	1	14	35
3	4	21	40
4	1	20	35
4	6	23	50
4	68	45	80
5	3	55	100
5	4	34	95
5	69	35	65
6	2	40	85
6	5	15	30
7	8	38	60
7	13	45	60
8	5	24	50
8	12	21	30
8	28	80	90
9	3	14	35
9	12	20	45
10	8	24	45
10	9	11	15
11	10	11	15
12	11	14	20
12	15	16	35
13	8	16	35
14	15	16	35
14	16	10	35
15	17	12	15
15	24	48	75
16	13	11	20
18	15	21	25
18	23	15	20
19	21	15	30
20	28	24	55
21	20	21	65
22	21	15	30
23	17	25	40
24	34	80	120

FROM CENTRE	TO CENTRE	DISTANCE (IN KMS)	TIME (IN MINS.)
25	23	14	20
26	25	25	45
26	28	27	30
27	30	14	20
28	15	50	75
28	22	21	45
28	27	17	15
28	29	30	35
28	57	126	120
28	63	110	130
28	66	40	40
29	51	51	70
30	26	18	45
30	31	35	45
31	35	25	55
32	26	33	45
32	31	24	30
33	32	14	20
34	35	50	120
35	33	22	35
35	36	14	20
36	38	39	65
36	39	16	45
37	35	50	60
38	43	55	95
38	70	40	50
39	33	30	55
39	38	50	68
39	40	42	85
39	46	62	120
40	46	29	95
41	42	27	50
41	46	23	45
42	28	56	85
43	45	50	90
44	45	27	40
44	46	27	45
45	58	19	180
46	51	30	50
47	41	52	90
47	54	41	65
48	29	18	30
48	65	35	80
49	28	62	60
49	48	20	30
49	50	32	45
50	52	10	20
51	49	24	40

FROM CENTRE	TO CENTRE	DISTANCE (IN KMS)	TIME (IN MINS.
51	53	20	25
52	51	10	15
52	55	30	35
52	61	35	45
53	54	25	20
53	56	18	20
54	57	18	45
55	49	22	30
55	62	35	45
55	64	12	30
56	52	15	20
56	57	50	60
57	51	72	145
57	58	45	45
57	61	30	45
58	47	48	90
58	59	10	10
59	60	25	15
60	57	18	15
61	49	54	60
61	53	50	60
61	62	15	15
62	28	103	130
62	56	30	40
63	55	50	55
63	61	20	30
64	50	50	75
65	55	45	95
66	21	19	45
66	67	60	105
67	7	32	75
68	2	25	55
68	5	30	95
69	68	90	125
70	37	75	115
Total		4106	6723
$\bar{x}$		33.7 kms	69.8 mins
	or	35 approx	70 approx.

APPENDIX II

SOURCE LOCATIONS & NUMBER OF MARKETERS FOR EACH CENTRE

CENTRE NAME	MARKET DAY	CYCLE ID	DEGREE OF VERTEX v-	DEGREE OF VERTEX v+	NET VERTEX *	NUMBER OF MARKETERS
IRAN	2	C	1	1	0	200
KAJE	3	C	2	3	-1	700
JOBO	4	C	2	2	0	280
JASI	1	C	4	1	3	650
KUTE	3	C	2	3	-1	500
NEWA	2	C	2	1	1	300
LAGO	6	F	1	2	-1	300
JHOE	2	C	3	4	-1	1540
KWAN	2	C	1	1	0	200
MURB	1	C	2	2	0	200
MURU	4	C	1	1	0	100
NKON	3	C	2	2	0	260
LODO	1	C	1	2	-1	200
JOLO	3	C	1	1	0	200
KPAN	4	C	2	4	-2	1080
MEBO	4	C	1	1	0	140
NFOE	1	C	0	2	-2	450
KAPO	3	C	2	0	2	340
MEJO	4	C	1	0	1	220
NEVA	2	C	1	1	0	200
KPEZ	1	C	1	3	-2	700
NIVE	4	C	1	1	0	280
JANA	4	C	1	2	-1	160
KOKO	5	F	1	1	0	160
KEPE	3	C	1	1	0	160
KLIT	2	C	2	2	0	220
KUSO	4	C	1	1	0	120
IHOT	3	C	7	6	1	2010
KPES	4	C	1	2	-1	400
KLOE	1	C	2	1	1	420
KPOD	2	C	1	2	-1	100
KISI	1	C	2	1	1	340
JUAP	4	C	2	1	1	300
NESE	2	C	1	1	0	1010
KPOO	3	C	2	3	-1	750
MANA	4	C	1	1	0	540
KOFO	2	C	1	1	0	2040
IDOT	2	C	2	1	1	500
KUSE	1	C	2	3	-1	400
MEYI	6	F	1	1	0	440
MEDI	1	C	2	1	1	840

CENTRE NAME	MARKET DAY	CYCLE ID	DEGREE OF VERTEX v-	v+	NET VERTEX *	NUMBER OF MARKETERS
KPEE	2	C	1	1	0	480
JESE	3	C	1	1	0	540
KASE	3	C	1	1	0	640
JAHO	4	C	1	1	-1	910
KKKO	4	C	3	2	1	600
LADA	2	C	2	2	0	260
IZOO	3	C	2	1	1	360
JAKA	2	C	2	2	0	450
LUDO	3	C	1	2	-1	240
NONE	1	C	2	4	-2	1700
JAWU	4	C	3	2	1	100
IIFE	2	C	2	2	0	150
NORF	3	C	1	2	-1	160
NOZE	1	C	2	3	-1	950
MEZU	3	C	1	2	-1	300
KETA	4	C	3	4	-1	1800
NYAN	1	C	2	1	1	140
JOBE	2	C	1	1	0	120
NOGA	3	C	1	1	0	600
NUDE	1	C	3	3	0	1500
IFLA	2	C	2	2	0	1600
LOME	4	C	2	1	1	2800
NOFE	2	C	1	1	0	-
NUZA	4	C	1	1	0	-
KPAL	4	C	2	1	1	-
KADO	5	F	1	1	0	-
JADU	2	C	2	2	0	-
JATA	4	C	1	2	-1	-
ICRY	DAILY	F	1	1	0	-

Note that:

(1) If cycle ID = C, then market periodicity is of the 4-day cycle.

(2) If cycle ID = F, then market periodicity is fixed as follows:

5 = Friday;
6 = Saturday; and
7 = Sunday

(3) Degree of Vertex values shown are derived from digraph links to each centre in the system of places in south-east Ghana such that

\+ = number of links converging on a centre (i.e., consumption capacity)
v- = number of links diverging from a centre (i.e., production capacity of the centre)

*Net vertex = (v-) - (v+)

APPENDIX III

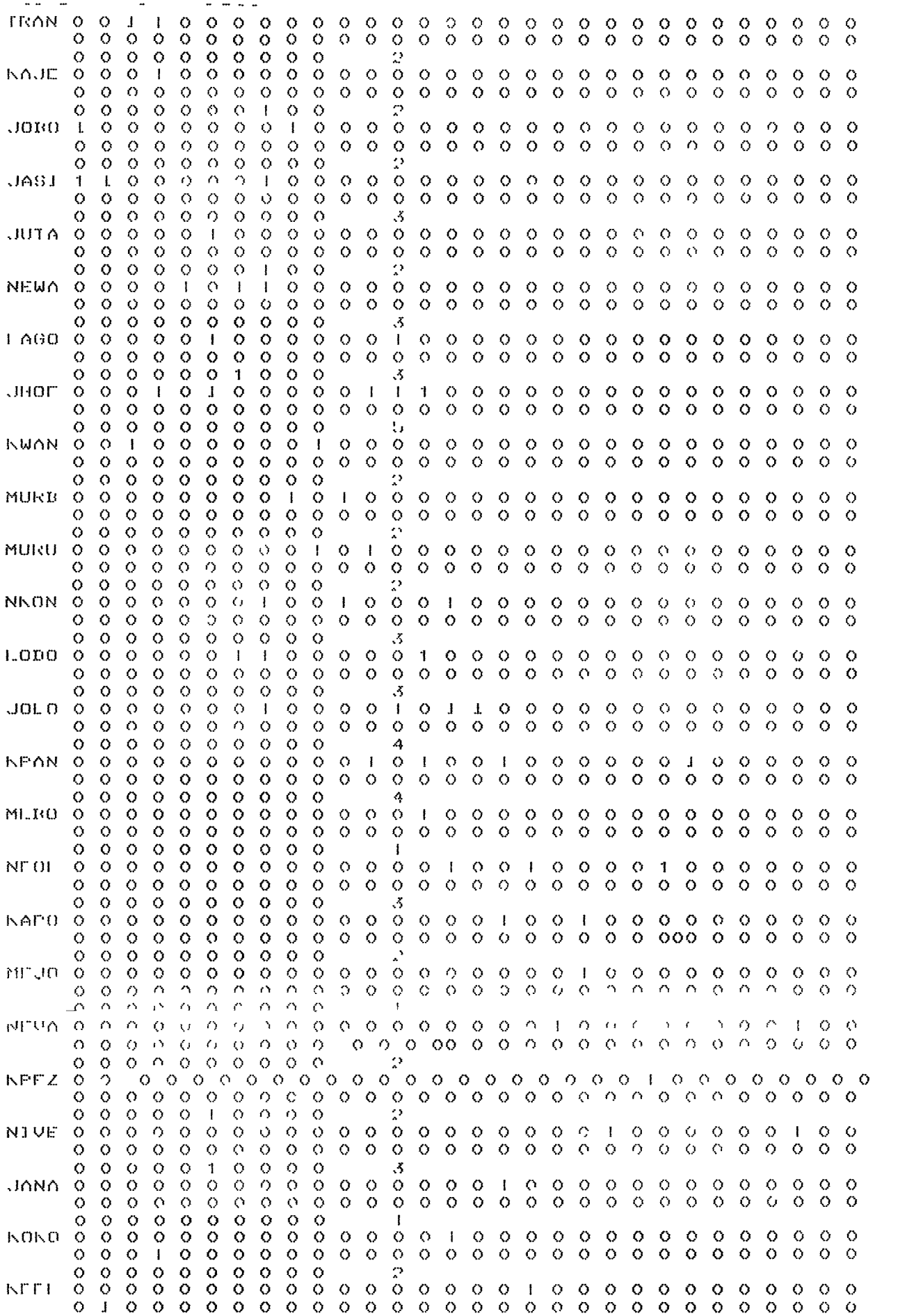
POPULATIONS AT EACH CENTRE

ID #	Centre Name	Computer Name	Population Number
1	Worawora	Iran	9,426
2	Kadjebi	Kaje	10,220
3	Abotoase	Jobo	8,343
4	Jasikan	Jasi	12,126
5	Kute	Kute	5,473
6	New Ayoma	Newa	4,523
7	Baglo	Lago	1,555
8	Hohoe	Jhoe	19,810
9	Kwamekrom	Kwan	3,109
10	Burbula	Murb	1,576
11	Wurupong	Muru	4,440
12	Nkonya-Ahenkro	Nkon	7,630
13	Fodome	Lodo	3,077
14	Golokwati	Jolo	5,101
15	Kpandu	Kpan	27,345
16	Agbome	Mebo	3,047
17	Anfoega	Nfoe	4,536
18	Vakpo	Kapo	7,766
19	Amedzofe	Mejo	2,877
20	Vane	Neva	4,392
21	Kpedze	Kpez	17,024
22	Nyive-Shia	Nive	4,396
23	Dzana-Botoku	Jana	5,138
24	Donkorkrom	Koko	8,844
25	Kpeve	Kefe	16,379
26	Tsito	Klit	6,184
27	Sokode	Kuso	5,751
28	Ho	Ihot	43,590
29	Kpetoe	Kpes	10,647
30	Abutia	Kloe	7,263
31	Podoe	Kpod	2,441
32	Asikuma	Kisi	7,999
33	Juapong	Juap	4,204
34	Asesewa	Nese	6,111
35	Kpong	Kpoo	17,411
36	Somanya	Mana	18,118
37	Koforidua	Kofo	69,776
38	Dodowa	Idot	11,429
39	Akuse	Kuse	8,498
40	Aveyime	Meyi	10,794

ID#	Centre Name	Computer Name	Population Number
41	Adidome	Medi	10,494
42	Asiekpe	Kpee	4,824
43	Sege	Jese	7,766
44	Kasse	Kase	5,101
45	Ada	Jaho	14,972
46	Sogakope	Kkko	16,208
47	Dabala	Lada	3,089
48	Ziope	Izoo	3,882
49	Dakpa-Afiadenyigba	Jaka	4,685
50	Tadzewu	Ludo	3,156
51	Akatsi	None	9,194
52	Ohawu	Jamu	1,659
53	Afife	Iife	3,511
54	Avenorfeme	Norf	2,175
55	Dzodze	Noze	20,251
56	Agbozume	Mezu	6,831
57	Keta	Keta	29,748
58	Anyanui	Nyan	2,194
59	Dzita-Srogboe	Jobe	3,713
60	Anloga	Noga	14,189
61	Denu	Nude	5,626
62	Aflao	Ifla	13,815
63	Lome	Lome	141,000
64	Noepe	Nofe	N/A*
65	Adzanu	Nuza	N/A
66	Kpalime	Kpal	N/A
67	Sado	Kado	N/A
68	Badu	Jadu	N/A
69	Atakpame	Jata	N/A
70	Acera	Icry	N/A

*N/A - Not available

APPENDIX V: MOTOR ROAD AND WATERWAY NETWORK MATRIX (RONFM) FOR STUDY REGION.



```
NIVE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 1 0 0 0 0     3
JANA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     1
KOKO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
KEFE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
KLIT 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0
     0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
KUSO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
IHOT 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 1 0 1 0
     0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     5
KPES 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
KLOE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0
     1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
KPOO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
     0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
JUAP 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
NESE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0
     0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
KPOO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
MANA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 1     4
KOFO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 1     3
IDOT 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     1
KUSE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
MEYI 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0   0 0   0 0 0 0 0     3
MEDI 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
KPEE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0
     0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
JESE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

```
JESE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 1     2
KASE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
JAHO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
KKKO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
LADA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
IZOO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 1 0 0 0 0 0     3
JAKA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
LUDO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
NONE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
JAWU 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 0 0 1 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     4
IIFE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     1
NORF 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     1
NOZE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0
     0 1 0 1 0 0 0   0 0 0     4
MEZU 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
     1 0 0 0 0 0 0 0 0 0     2
KETA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
     1 0 0 0 0 0 0 0 0 0     2
NYAN 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
JOBE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0
     0 0 0 0 0 0 0 0 0 0     2
NOGA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0
     0 0 0 0 0 0 0 0 0 0     2
NUDE 0 00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0
     0 1 0 0 0 0 0 0 0 0     3
IFLA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0
     1 0 1 0 0 0 0 0 0 0     3
LOME 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 1 0 1 0 0 0 0 0 0     2
NOFF 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

```
      1 0 0 0 0 0 0 0 0 0       2
NYAN  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0
      0 0 0 0 0 0 0 0 0 0       2
JCBE  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1
      0 0 0 0 0 0 0 0 0 0       2
NOGA  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0
      0 0 0 0 0 0 0 0 0 0       2
NUDE  0 00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0
      0 1 0 0 0 0 0 0 0 0       3
IFLA  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0
      1 0 1 0 0 0 0 0 0 0       3
LOME  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 1 0 1 0 0 0 0 0 0       2
NOFE  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0
      0 0 1 0 1 0 0 0 0 0       3
NUZA  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 1 0 1 0 0 0 0       3
KPAL  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 1 0 1 0 0 0       4
KADO  0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 1 0 0 1 0       3
JADU  0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 1 0       3
JATA  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 1 1 0 0       2
ICRY  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 1 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       3
```

END

!

APPENDIX IV: MARKET SEQUENCE MATRIX(MARKSEM) FOR STUDY REGION.

IRAN	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			2																		
KAJE	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	1	0			5																		
JOBO	0	1	9	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			4																		
JASI	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0			5																		
JUTE	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	1	0			4																		
NEWA	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			3																		
LAGO	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0			3																		
JHOE	0	0	0	1	1	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			7																		
KWAN	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			2																		
MURB	0	0	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			4																		
MURUO	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			2																		
NKON	0	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			4																		
LODO	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			3																		
JOLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			2																		
KPAN	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			6																		
MEBO	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			2																		
NFOE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			3																		
KAFO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			3																		
MEJO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			1																		
NEVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0			2																		
KPEZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0

```
      0 0 0 0 0 0 0 0 0 0       2
KPEZ  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 1 0 0 0 0       4
NIVE  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       2
JANA  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 1 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       3
KOKO  0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       2
KEFE  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       2
KLIT  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 1
      0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       4
KUSO  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       2
IHOT  0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 1 0 1 0 0 0 1 1 0 1 0
      0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0
      0 1 1 0 0 1 0 0 0 0      13
KPES  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       3
KLOE  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       3
KPOO  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
      0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       3
KISI  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
      1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       3
JUAP  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 1 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       3
NESE  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0
      0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       2
KPOO  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      1 0 1 1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       5
MANA  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       2
KOFO  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 1       2
IDOT  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 1       3
KUSE  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 1 0 0 1 0 1 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       5
MEYI  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       2
MEYI  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0
      0 0 0 0 0 0 0 0 0 0       3
KPEE  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
```

```
KPEE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
     0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
JESE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
KASE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     2
JAHO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
KKKO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     5
LADA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 1 0 0 0
     0 0 0 0 0 0 0 0 0 0     4
IZOO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 1 0 0 0 0 0     3
JAKA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0
     1 0 0 0 0 0 0 0 0 0     4
LUDO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0
     0 0 0 1 0 0 0 0 0 0     3
NONE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 1 1 0 0 0 1 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     6
JAWU 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 1 1 0 0 0 0
     1 0 0 0 0 0 0 0 0 0     5
IIFE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 1 0 0 0 0 0
     1 0 0 0 0 0 0 0 0 0     4
NORF 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0     3
NOZE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0
     0 1 1 1 1 0 0 0 0 0     5
MEZU 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 1 0 0 0 0
     0 1 0 0 0 0 0 0 0 0     4
KETA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 1 0 1 0 1 0 1
     1 0 0 0 0 0 0 0 0 0     7
NYAN 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 1 0 1 0 0 0
     0 0 0 0 0 0 0 0 0 0     4
JOBE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0
     0 0 0 0 0 0 0 0 0 0     2
NOGA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0
     0 0 0 0 0 0 0 0 0 0     2
NUDE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 1 0 0 0 1 0 0 0 0
     0 1 1 0 0 0 0 0 0 0     6
IFLA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0
     1 0 0 0 0 0 0 0 0 0     4
LOME 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
```

```
KOLE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 1 0 0 0 1 0 0 0
     0 1 1 0 0 0 0 0 0 0 6
IFLA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0
     1 0 0 0 0 0 0 0 0 0 4
LOME 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0
     1 0 0 0 0 0 0 0 0 0 3
NOFE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 2
NUZA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 2
KPAL 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 1 0 0 0 3
KADO 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 1 0 0 0 0 2
JADU 0 1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 1 0 4
JATA 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 1 0 0 3
ICRY 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0 0 0 2
END

!
```

APPENDIX VI

CALENDAR SCHEDULE FOR STUDY REGION

English Schedule	# of Days	Local Name	# of Days
January	31	Dzove	28
February	28	Dzodze	28
March	31	Tedoxe	28
April	30	Afofie	28
May	31	Dame	28
June	30	Masa	28
July	31	Siamlom	28
August	31	Dasiamime	28
September	30	Anyonyo	28
October	31	Kele	28
November	30	Ademekpoze	28
December	31	Dzome	28
		Foave	28
Total	365		364

APPENDIX VII

RANKING AND DISTRIBUTION OF "ATTRACTION FACTOR"

Range	Score	Rank	Distribution	Mean
0.0 - 2.0	-1	21	3	
2.1 - 4.2	-2	22	17	
4.3 - 6.3	-3	23	17	
6.4 - 6.6	1	11	5	6.5
6.7 - 13.0	2	12	17	
13.1 - 19.5	3	13	3	
19.6+	4	14	1	
		Total	63	

APPENDIX VIII

RANK, CLASSIFICATION AND DISTRIBUTION

OF 'CENTRALITY-CIRCULATION FACTOR'

Range for Centrality	Net Vertex*	Score	Rank	Classification	Distribution	Mean for Net Vertex
1 - 2	0	-1				
1 - 2	1	-2				
1 - 2	-1	-3	21			
3 - 4	-1	-4				
5	-1	-5				
6 - 8	-1	-6				
1 - 2	2	-7				
3 - 4	-2	-8	22	'PARASITES'	35	
5	-2	-9				
6 - 8	-2	-10				
1 - 2	3	-11				
3 - 4	-3	-12	23			
5	-3	-13				
6 - 8	-3	-14				3.7
3 - 4	0	1				
5	0	2	11			
6 - 8	0	3				
3 - 4	1	4		'GENERATORS'	28	
5	1	5	12			
6 - 8	1	6				
3 - 4	2	7				
5	2	8	13			
6 - 8	2	9				

*Net Vertex = (v-) - (v+) as in Appendix II

APPENDIX IX

ESTIMATION OF RANK SCORES FOR CENTRES IN STUDY REGION

		ATTRACTION FACTOR					CENTRALITY-CIRCULATION FACTOR				
A Computer Name	B ID #	C Population	D Marketers	E $\left(\frac{D}{c} \times 100\right)$ (%)	F Score*	G Rank*	H Net Vertex	J Centrality Index	K Score**	L Rank**	Z Composite Rank***
IRAN	1	9426	200	2.1	-2	22	-0	2	-1	21	2221
KAJE	2	10220	700	6.8	2	12	-1	5	-5	21	1221
JOBO	3	8343	280	3.4	-2	22	0	4	1	11	2211
JASI	4	12126	650	5.4	-3	23	3	5	9	13	2313
KUTE	5	5473	500	9.1	2	12	-1	5	-5	21	1221
NEWA	6	4523	300	6.6	1	11	1	3	4	12	1112
LAGO	7	1555	300	19.3	3	13	-1	3	4	12	1312
JHOE	8	19810	1540	7.7	2	12	-1	7	-6	21	1221
KWAN	9	3109	200	6.4	1	11	0	2	-1	21	1121
MURB	10	1576	200	12.7	2	12	0	4	1	11	1211
MURU	11	4440	100	2.3	-2	22	0	2	-1	21	2221
NKON	12	7630	260	3.4	-2	22	0	4	1	11	2211
LODO	13	3077	200	6.5	1	11	-1	3	-4	21	1121
JOLO	14	5101	200	3.9	-2	22	0	2	-1	21	2221
KPAN	15	27345	1080	3.9	-2	22	-2	6	-10	22	2222
MEBO	16	3047	140	4.6	-3	23	0	2	-1	21	2321
NFOE	17	4536	450	9.9	2	12	-2	3	-8	22	1222
KAPO	18	7766	340	4.4	-3	23	2	3	7	13	2313
MEJO	19	2877	220	7.7	2	12	1	1	-2	21	1221
NEVA	20	4392	200	4.6	-3	23	0	2	-1	21	2321

		ATTRACTION FACTOR				CENTRALITY-CIRCULATION FACTOR					
Computer Name	B ID #	C Population	D Marketers	E $\frac{D}{C}$ x 100 (%)	F Score*	G Rank*	H Net Vertex	J Central-ity Index	K Score**	L Rank**	Z Composite Rank***
KPEZ	21	17024	700	4.1	-2	22	-2	4	-8	22	2222
NIVE	22	4396	280	6.4	1	11	0	2	-1	21	1121
JANA	23	5138	160	3 1	-2	22	-1	3	-4	21	2221
KOKO	24	8844	160	1.8	-1	21	0	2	-1	21	2121
KEFE	25	16379	200	1.2	-1	21	0	2	-1	21	2121
KLIT	26	6184	220	3.6	-2	22	0	4	1	11	2211
KUSO	27	5751	120	2.1	-2	22	0	2	-1	21	2221
IHOT	28	43590	2010	4.6	-3	23	1	13	6	12	2312
KPES	29	10647	400	3.8	-2	22	-1	3	4	12	2212
KLOE	30	7263	420	5.8	-3	23	1	3	4	12	2312
KPOD	31	2241	100	4.5	-3	23	-1	3	-4	21	2321
KISI	32	7999	340	4.3	-3	23	1	3	4	12	2312
JUAP	33	4204	300	7.1	2	12	1	3	4	12	1212
NESE	34	6111	1010	16.5	3	13	0	2	-1	21	1321
KPOO	35	17411	750	4.3	-3	23	-1	5	-5	22	2322
MANA	36	18118	540	3.0	-2	22	0	2	-1	21	2221
KOFO	37	69776	2040	2.9	-2	22	0	2	-1	21	2221
IDOT	38	11429	500	4.4	-3	23	1	3	4	12	2312
KUSE	39	8498	400	4.7	-3	23	-1	5	5	12	2312
MEYI	40	10794	440	4.1	-2	22	0	2	-1	21	2221
MEDI	41	10494	840	8.0	2	12	1	2	-2	21	1221
KPEE	42	4824	480	10.0	2	12	0	2	-1	21	1221
JESE	43	7766	540	7.0	2	12	0	2	-1	21	1221
KASE	44	5101	640	12.6	2	12	0	2	-1	21	1221
JAHO	45	14972	910	6.1	-3	23	-1	3	-4	21	2321
KKKO	46	16208	600	3.7	-2	22	1	4	4	12	2212
LADA	47	3089	260	8.4	2	12	0	4	1	11	1211
IZOO	48	3882	360	9.3	2	12	1	3	4	12	1212
JAKA	49	4685	450	9.6	2	12	0	4	1	11	1211
LUDO	50	3156	240	7.6	2	12	-1	3	-4	21	1221

		ATTRACTION FACTOR				CENTRALITY-CIRCULATION FACTOR					
	B	C	D	E	F	G	H	J	K	L	Z
Computer Name	ID #	Population	Marketers	$\frac{D}{c}$ x 100 (%)	Score*	Rank*	Net Vertex	Centrality Index	Score***	Rank**	Composite Rank***
NONE	51	9194	1700	18.5	3	13	-2	6	-10	22	1322
JAWU	52	1659	100	6.0	-3	23	1	5	5	12	2312
IIFE	53	3511	150	4.3	-3	23	0	4	1	11	2311
BIRF	54	2175	160	7.4	2	12	-1	3	4	12	1212
NOZE	55	20217	950	4.7	-3	23	-1	5	-5	21	2321
MEZU	56	6831	300	4.4	-3	23	-1	-4	-4	11	2311
KETA	57	29746	1800	6.1	-3	23	-1	7	-6	21	2321
NYAN	58	2194	140	6.4	1	11	1	4	4	12	1112
JOBE	59	3713	120	3.2	-2	22	0	2	-1	21	2221
NOGA	60	14189	600	4.2	-2	22	0	2	-1	21	2221
NUDE	61	6526	1500	23.0	4	14	0	7	3	11	1411
IFLA	62	13815	1600	11.6	2	12	0	4	1	11	1211
LOME	63	141000	2800	2.0	-1	21	1	3	4	12	2112

*For details, see Appendix VII

**For details, see Appendix VIII

***Combination of ranks in Columns G and L

APPENDIX X

Saleman's Tour Schedules and the Determination of Circuits--1

Step Number	Day 1 Circuits								
	Circuit 10			Circuit 41			Circuit 58		
	Centre Reached	Distance (in kms)	Time (in mins)	Centre Reached	Distance (in kms)	Time (in mins)	Centre Reached	Distance (in kms)	Time (in mins)
1	10	-	-	41	-	-	58	-	-
2	8	24	45	47	52	90	59	10	10
3	5	24	50	54	41	65	60	25	15
4	3	55	100	57	18	45	57	18	15
5	4	21	40	58	45	45	61	30	45
6	6	23	50	59	10	10	62	15	15
7	2	40	85	60	25	15	28	103	130
8	3	35	75	57	18	15	29	30	35
9	10	27	60	51	72	145	51	51	70
10	9	11	15	53	20	25	53	20	25
11	12	20	45	56	18	20	56	18	20
12	15	16	35	52	15	20	57	50	60
13	14	16	35	61	35	45	51	72	145
14	16	10	35	62	15	15	47	24	40
15	13	11	20	28	103	130	54	41	65
16	8	16	35	27	17	15	57	18	45
17	28	80	90	30	14	20	51	72	145
18	22	21	45	31	35	45	53	20	25
19	21	15	30	35	25	55	56	18	20
20	20	21	65	33	22	35	52	15	20
21	28	24	55	32	14	20	61	35	45
22	66	40	40	31	24	30	62	15	15
23	67	60	105	35	25	55	28	103	130
24	7	32	75	36	14	20	57	126	120
25	13	45	60	39	16	45	51	72	145
26	8	16	35	40	42	85	53	20	25
27	12	21	30	46	29	95	56	18	20
28	11	14	20	41	23	45	57	50	60
29	10	11	15	41	-	-	58	45	45
Total		749	1395		787	1250		1134	1550
Mean		26.8	49.6		29.2	46.3		40.5	55.4

APPENDIX XI

Salesmen's Tour Schedules and the Determination of Circuits--2

Step Number	Day 1 and Day 2 Circuits								
	Circuit 61--Day 1			Circuit 49--Day 2			Circuit 62--Day 2		
	Centre Reached	Distance (in kms)	Time (in mins)	Centre Reached	Distance (in kms)	Time (in mins)	Centre Reached	Distance (in kms)	Time (in mins)
1	61	-	-	49	-	-	62	-	-
2	62	15	15	50	32	45	28	103	130
3	56	30	40	52	10	20	22	21	45
4	52	15	20	55	30	35	21	15	30
5	55	30	35	64	12	30	20	21	65
6	64	12	30	50	50	75	28	24	55
7	50	50	75	52	10	20	57	126	120
8	52	10	20	51	10	15	58	45	45
9	51	10	15	47	24	40	59	10	10
10	47	24	40	54	41	65	60	25	15
11	54	41	65	57	18	45	57	18	15
12	57	18	45	58	45	45	61	30	45
13	58	45	45	59	10	10	62	15	15
14	59	10	10	60	25	15	56	30	40
15	60	25	15	57	18	15	52	15	20
16	57	18	15	61	30	45	51	10	15
17	51	72	145	62	15	15	53	20	25
18	53	20	25	28	103	130	54	25	20
19	56	18	20	29	30	35	57	18	45
20	52	15	20	51	51	70	58	45	45
21	61	35	45	47	24	40	59	10	10
22	49	54	60	54	41	65	60	25	15
23	48	20	30	57	18	45	57	18	15
24	65	35	80	61	30	45	51	72	145
25	55	45	95	53	50	60	47	24	40
26	62	35	45	56	18	20	54	41	65
27	56	30	40	52	15	20	57	18	45
28	52	15	20	61	35	45	61	30	45
29	61	35	45	49	54	60	62	15	15
Total		782	1155		849	1170		869	1195
Mean		27.9	41.3		30.3	41.8		31.0	42.7

APPENDIX XII

Salesmen's Tour Schedules and the Determination of Circuits--3

Step Number	Days 3 and 4 Circuits								
	Circuit 48--Day 3			Circuit 54--Day 3			Circuit 33--Day 4		
	Centre Reached	Distance (in kms)	Time (in mins)	Centre Reached	Distance (in kms)	Time (in mins)	Centre Reached	Distance (in kms)	Time (in mins)
1	48	-	-	54	-	-	33	-	-
2	29	18	30	57	18	45	39	30	55
3	51	51	70	58	45	45	40	42	85
4	53	20	25	59	10	10	46	29	95
5	56	18	20	60	25	15	41	23	45
6	52	15	20	57	18	15	42	27	50
7	55	30	35	61	30	45	28	56	85
8	62	35	45	49	54	60	27	17	15
9	28	103	130	50	32	45	30	14	20
10	29	30	35	52	10	20	31	35	45
11	51	51	70	55	30	35	35	25	55
12	47	24	40	64	12	30	33	22	35
13	54	41	65	50	50	75	39	30	55
14	57	18	45	52	10	20	38	50	68
15	58	45	45	61	35	45	70	40	70
16	59	10	10	62	15	15	37	75	115
17	60	25	15	56	30	40	35	50	60
18	57	18	15	57	50	60	33	22	35
19	61	30	45	51	72	145	32	14	20
20	62	15	15	47	24	40	26	33	45
21	56	30	40	54	41	65	25	25	45
22	52	15	20	57	18	45	23	14	20
23	55	30	35	61	30	45	17	25	40
24	64	12	30	49	54	60	18	24	30
25	50	50	75	50	32	45	15	21	15
26	52	10	20	52	10	20	24	48	75
27	61	35	45	51	10	15	34	80	120
28	49	54	60	47	24	40	35	50	120
29	48	20	30	54	41	65	33	22	35
Total		853	1129		830	1205		943	1553
Mean		30.5	40.3		29.6	43.0		33.7	55.5

APPENDIX VIII: DISTRIBUTION OF VISITS TO CENTRES FROM DERIVED CIRCUITS.

CENTRE VISITED I.D.	NUMBER OF VISITS FROM CIRCUIT 10	CIRCUIT 33	CIRCUIT 39	CENTRE VISITED I.D.	NUMBER OF VISITS FROM CIRCUIT 10	CIRCUIT 33	CIRCUIT 39	
1.				0	36.			0
2.	/			1	37.		/	1
3.	//				38.		/	1
4	/			1	39.		//	2
5.	/			1	40.		/	1
6.	/			1	41.		/	1
7.	/			1	42.		/	1
8.	///			3	43.			0
9.	/			1	44.			0
10.	///			3	45.			0
11.	/			1	46.		/	1
12.	//			2	47.			// 2
13.	//			2	48.			0
14.	/			1	49.			/ 1
15.	/	/		2	50.			// 2
16.	/			1	51.			// 2
17.		/		1	52.			/// 3
18.		/		1	53.			/ 1
19.				0	54.			// 2
20.	/			1	55.			/ 1
21.	/			1	56.			/ 1
22	/			1	57.			/// 3
23.		/		1	58.			/ 1
24.		/		1	59.			/ 1
25.		/		1	60.			/ 1
26.		/		1	61.			/// 3
27.		/		1	62.			/ 1
28.	//	/	/	3	63.			0
29.			/	1	64.			/ 1
30.		/		1	65.			1
31.		/		1	66	/		1
32.		/		1	67.	/		1
33.		///		4	68.			0
34.		/		1	69.			0
35.		///		3	70.		/	1

END
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